
R.S.

THE

RAY SOCIETY.

INSTITUTED MDCCCXLIV.

This volume is issued to the Subscribers to the RAY SOCIETY *for the Year* 1886.

LONDON:

MDCCCLXXXVII.

THE LARVÆ

OF THE

BRITISH BUTTERFLIES

AND

MOTHS.

BY

(THE LATE)

WILLIAM BUCKLER,

EDITED BY

H. T. STAINTON, F.R.S.

VOL. II.

(THE SPHINGES OR HAWK-MOTHS AND PART OF THE BOMBYCES.)

LONDON:
PRINTED FOR THE RAY SOCIETY.

MDCCCLXXXVII.

[1887]

PRINTED BY ADLARD AND SON, BARTHOLOMEW CLOSE.

PREFACE.

RATHER more than a year ago I led my readers to expect a second volume (of Mr. Buckler's larvæ of the British Butterflies and Moths) treating of the larvæ of our Sphinges or Hawk-Moths.

The present volume is rather in excess of what I had then contemplated, as it includes not only the larvæ of nearly all our Sphinges or Hawk-Moths (the only omissions being *Naclia ancilla*, *Chærocampa nerii*, *Trochilium vespiforme*, and *allantiforme*) but also the larvæ of the first twenty-seven of our Bombyces.

The larvæ of the remainder of our Bombyces will form the subject of a third volume, which will be issued to the subscribers for the year 1888.

The present year (1887) being required for a volume on *Oribatidæ* by Mr. A. D. Michael, necessitates a break in the annual series of larvæ volumes; but I may mention that the first twelve plates of Vol. III are already on the stone, most carefully executed, like those in the present volume, by Mr. F. C. Moore.

As in the preceding volume, though the series of figures left by the late Mr. Buckler was wonderfully complete, of a great number he had left no descriptions. To supply these gaps in the letterpress, the Rev. John Hellins has not only exerted himself, but

has enlisted the aid of his friends to an extraordinary degree.

As in the previous volume the letters W. B., or J. H., after each description indicate whether written by William Buckler or by John Hellins, and the figures immediately following give the date when the description was written for publication, the reference that follows being to the volume and page of the 'Entomologists' Monthly Magazine' or to Mr. Buckler's Note Books.

To Mr. G. C. Bignell we are again indebted for a list of the parasites bred from the larvæ, of which the present volume treats.

H. T. STAINTON.

MOUNTSFIELD, LEWISHAM;
January 20*th*, 1887.

CONTENTS OF VOL. II.

CLASSIFIED LIST OF THE SPECIES

IN THIS VOLUME.

HETEROCERA.

---

* *Naclia ancilla* of the Family SYNTOMIDÆ does not occur in this volume, Mr. Buckler never having obtained either eggs or larva.

---

* *Chœrocampa nerii* does not occur in this volume, Mr. Buckler never having obtained either eggs or larva.

† *Trochilium vespiforme* and *allantiforme* do not occur in this volume Mr. Buckler never having obtained either eggs or larvæ.

* The genus *Microdonta* was created by Duponchel, in his 'Catalogue,' p. 93 (1844) for the reception of this species. He says: "Ailes larges à frange simple, avec la dent du bord interne des supérieures peu prononcée."

THE LARVÆ

OF THE

BRITISH MOTHS.

Procris globulariæ.

Plate XVIII, fig. 2.

On the 25th of June, 1882, I had the pleasure to receive from Herr Heinrich Disqué, of Speier, several eggs of *Procris globulariæ*, together with the parent moth herself, which he had induced to deposit her eggs in a small cylindrical box with glass ends; one egg hatched on July 10th, but the larva was killed in the effort to take it from the cylinder; on the 14th, five or six larvæ were hatched, but I was unable to extract more than two of them uninjured, as they all were much entangled with web or remains of cotton wool obstinately clinging to the box; the remaining eggs hatched next day, but most unfortunately just when my vision became disturbed from a bilious derangement, and the larvæ from them were all fatally injured in my attempts to get them out of the box, as next day with sight restored I saw them lying dead on the leaves of *Centaurea*.

I now looked for the two larvæ that had previously been safely put with a leaf of *Centaurea nigra* in a small tin box, but could discern neither of them until I held the leaf against the light, then at once I saw

them both embedded in its substance, each appearing about the size of a small flea in a semi-transparent spot between the upper and under skin of the leaf, and these spots, when afterwards vacated, became clear blotches on the surface. The larvæ on emerging to the light were seen to have grown a little, and soon made their way into a fresh piece of similar leaf, which began to show several such blotches where the parenchyma was eaten out.

On the 25th of July one came out of the leaf, and the next day the other, when a fresh leaf was provided; but neither would attack it, and they sat still on the old one until the 3rd and 4th of August, when, after moulting, they entered fresh leaves, which continued to be supplied to them in the box every two or three days. Their second moult occurred after they had left the leaves and sat still for nine or ten days, on the 13th and 14th of August, when, after an interval of rest, they again mined into the fresh leaves making numerous clear spots on their surfaces, but only for about three or four days, as they were out of their mines again on the 18th, and were spinning little mats of silk, on which they fixed themselves to wait for their third moult which happened on the 23rd to 27th of the month.

By the 3rd of September, the one more advanced in growth than the other had laid itself up on a silken mat, spun on the upper surface of the midrib of a leaf whose sides swelling up made a desirable sheltered situation to be fixed in, while its companion at this time was to be seen in the middle of a comparatively large mined blister, from which, as from the very first, the black "frass" continued to be extruded a day or two longer. The former accomplished its fourth moult September 12th, the latter on the 14th; the first, after a three days' rest from what seemed an exhausting operation, again mined into the leaves, and after an interval its companion also, both growing a little, while making large blister-like mines.

On the 9th of October they were out of their mines, had ceased to feed, and seemed to be hibernating; and this I made sure of on the 21st, when I closely examined them and saw that each larva had its feet on a silken mat, and that one of them had a stay of a few threads passed over its back attached to the stout midrib and to the underside of the piece of leaf it was on; each of these pieces, already becoming discoloured, with their occupants attached, I then placed at the base of the plant of *Centaurea* from which nearly all their food had been gathered, and which I had recently dug up and potted for their reception during the winter; one being laid on a dry leaf, the other on a radical sprouting leaf. I looked for them early in November, and saw the pieces of leaf were nearly rotten and deserted by the larvæ, they having entirely gone from view.

On the 17th of February, 1883, while noticing the few large leaves on the plant which I kept in a window, I chanced to observe two small watch-pocket-like apertures cut in the upper epidermis of one of them, and two minute black atoms of "frass" lying near, and in the course of a week these hopeful appearances were seen on more of the leaves, and began to increase in number, but all of them were very small, and it was not before the morning of the 25th that I was gratified with the welcome sight of one of the larvæ, the only one it seemed that had survived the winter thus far; it was on the upper surface of a leaf, creeping deliberately along the midrib towards the foot-stalk; in the afternoon I could see it attached to the underside of a neighbouring leaf.

The next morning after vainly looking all over the plant, I found it had crawled off and was lodged on the rim of the flower-pot, a circumstance that led me to reflect on the roving disposition it had so soon betrayed, there being evidence that it had wandered all over the plant; so now, for fear of losing it, I again placed it in the captivity of a box, where for a day or two it mined into a gathered leaf and ate out the

parenchyma from a largish area just as it had done in the autumn; then I gave it more light and air, but by the 6th of March it had made only five mines, each no bigger than itself, of irregular oval shape, and all through the remainder of this month of cold north-east wind it did not feed, but laid up as though asleep, until the 1st of April, when it removed to a fresh leaf, but without feeding; afterwards it again moved to one or two other fresh leaves, and even made a small puncture in them, but it did not feed. On the 5th of April it seemed unable to keep on its feet, appeared in a moribund state, and was dead by next morning.

I lost no time in communicating this mishap, and sending a pencil sketch of the defunct to Herr H. Disqué, who with most obliging good nature, which I am so glad now to acknowledge thankfully, at some sacrifice of time, sought out the distant spot where he had captured the insect last year, and actually succeeded in finding a larva of *globulariæ* no bigger than the little one so recently lost, an instance of keen sight faculty, which astonished as much as it delighted me when I received the larva on the 2nd of May, while it was yet fixed on a leaf of *Centaurea* waiting the next moult. This was accomplished on the 9th, seemingly an exhausting process, as the larva remained quietly resting for two days and a half before beginning to feed; for two days it ate sparingly, but thenceforward more freely, making larger blotches, until the 22nd, when it left its food to seek a suitable place in which to lie up, and after being at a corner of the box for some hours it eventually moved off to another part under the lid, where, on the 24th, it spun a foot-mat of silk threads, and became fixed in them feet uppermost, until the moult took place on the 30th; and finally it became full-fed on the 11th of June, and later entered the earth.

In addition, Herr H. Disqué most kindly sent me on the 6th of May, four fine larvæ, at that time a moult in advance of the foregoing, and their last moult

occurred on the 18th, 19th, and 20th of the month. They all fed remarkably well, making very large and conspicuous blisters or mines in the leaves, from which they devoured the parenchyma to a great extent, even sometimes abstracting nearly the whole from a leaf; towards the last they were somewhat careless in not extruding all their "frass," which could be seen in a long trail within some of the clear blisters, and they often remained within them at night and for many hours at a time, apparently asleep, when their form could be readily seen through the transparent cuticle. In this way they attacked quantities of leaves, but just at the last, and in one instance only, a larva ate a large hole quite through the entire substance of a leaf.

Their full growth was attained from May 30th to the 2nd of June, and then each in turn lingered two, three, or four days on the surface before entering the earth.

From three of the pupæ the perfect insects, two males and a female, were bred on the 9th of July, having been preceded a few days by an Ichneumon from the fourth, which I have since learned from a friend has been pronounced by Mr. Bridgman to be an undescribed species of *Anomalon*.

The egg of *globulariæ* is of a long-oval shape, about $\frac{1}{40}''$ long and $\frac{1}{70}''$ wide, having at first a depression on some part of the surface, and adhering lengthways to the substance whereon laid, singly, or sometimes two or three together. The shell is very finely ribbed, and of a deep yellow colour, which changes a few hours before hatching to a dull pinkish or to a light-brownish tint, showing a deeper brown spot at one end, and by that time the egg has become very plump.

The larva, when first hatched, is of a short dumpy figure, with small black and glossy retractile head, the second segment bears a glossy brownish plate having a broad black dotted streak tapering to a point at the front, and on either side a black streak; the other segments of the body are faintly tinted with greenish-drab, and covered with a short fine whitish pubescence.

After seven days' feeding it reappears fat and plump, the pubescence less noticeable, more of the skin visible and glistening as it sits still on a leaf.

After the first moult, while quietly resting it appears to be a mass of bristly tubercles, and of a fresh light green colour, but by the time it has again ceased feeding and is laid up on a leaf for the next moult, the glistening skin has a greenish-buff tint, as from its plumpness the bristles are farther apart and allow this to be seen.

After the second moult it is still fresher and greener than at any time before, though when its few days of feeding in the mine have passed, and it has again laid up, it is of a deep pinkish flesh colour.

After the third moult its colour at first is quite dark slaty-green, matching very well with that of the leaves of its food-plant; between the rows of tubercles down the back can be discerned a thin dingy, purplish-brown dorsal line, spreading a little at each segmental division; the tubercles are covered with short radiating bristles of a drab colour; but when it is again laid up it is very much lighter and the glistening skin is of an ochreous-green.

After its fourth moult, and it has fed a few days, when seen with the two front segments fully stretched out, it is $3\frac{1}{2}$ mm. in length, but later, when fixed for hibernation with the two front segments retracted, it appears not longer than 3 mm., its figure a broad oval, like that of a small hemp-seed, and it is covered with closely-set bristly tubercles and a few longer fine hairs; three rows of tubercles are on either side of the body in a longitudinal direction, so that six tubercles of broad-oval shape surround each segment except on the belly, which is naked; between the two which occupy the back of a segment is a black arrow-head mark; these dorsal tubercles are very dark dingy brownish-green with yellowish-green outer edges along the subdorsal region, relieved by a fine blackish line beneath; the dusky bristles make the general colouring

intensely dark on the upper surface, the smooth belly and legs being of a greenish-drab colour.

After hibernation, just at first, the larva appears almost black, but after feeding a little its dark green colour becomes fresher, and the outer margins of the dorsal tubercles more conspicuously yellowish-green.

Immediately after the next moult it seems to be thickly enveloped with radiating bristles of a tender bluish-green mixed with whitish, whilst it sits to recover strength, and as soon as it recommences feeding its growth quickly brings the length to 10 mm. and a more lively colouring; the bluish-green dorsal tubercles are strikingly defined by a creamy-white subdorsal stripe on which their outer margins encroach a little, a widish stripe of a dark green follows, contrasting with the lighter green tubercles and skin below.

After the last moult, full growth being attained, the larva measures when stretched out from 13 to 14 mm. in length, the greatest width across the middle of the body 5 mm.; it tapers a little at either end and is rounded off behind, and also in front when at rest with the first two segments retracted. The head is extremely small and flattened, the segments are plump and very deeply divided, the second is smooth and glossy, the tubercles are slightly raised, large, occupying nearly the length of a segment, except the lowest just above the feet, which are rather smaller; in shape they are roundish ovate, the dorsal pair side by side on each segment are set close and obliquely together in front, leaving between them a small central arrow-head-like space behind at the division. The legs are rather short and well under the body, the belly flattened and smooth.

In colour the head is black, the antennal papillæ greenish-white tipped with black, the second segment greenish with broad black marking or plate tapering towards the front, the tubercles on the back are of rather light bluish-green, the dorsal row of markings

black, the white subdorsal marking inclines to creamy-white, sometimes to yellowish-white, this is contrasted strongly below by a broadish stripe of dark green tapering towards the head and a little also to the hinder part of the body; on the smooth skin between the dorsal tubercles at the beginning of each segment and of the white subdorsal marking are sprinkled some most minute black dots, only a few are on the white where it is broadest, but they are numerous on the dark green stripe following it; the side below is entirely green including the tubercles, and the whole of them are studded thickly with short and fine blackish bristles, the spiracles black, anterior legs black, the belly and ventral prolegs green.

The situation of the cocoons could be detected by very slight elevations on the surface of the deep pot of earth, where, before the larvæ had buried themselves, all had been quite level, and when the cocoons were removed from only just below the surface, for inspection after the insects were bred, I found each was of broad-oval shape about 9 lines by 7 or 8, exteriorly composed of grains of earth very firmly united to a few fibres of grass-roots, of which there were plenty in the turfy soil and which served to bind all together. On removing the earthy particles I reached the inner cocoon of opaque greenish-white soft silk, yet strong and elastic, reminding me in these qualities of that of *Odonestis potatoria*, and in the softness of its closely-woven interior of that of *Bombyx mori;* it was 7 lines long and 3 lines wide, rounded off anteriorly, widest in the middle, and tapered to a blunt point at the posterior end.

In each instance (except one) the pupa had evidently emerged from the cocoon and travelled away from it a little distance, as I found the pupa-skins thus lying on the bare earth, and only the old larval-skin lay shrivelled up at the bottom of the deserted cocoons; but the one from whence the *Anomalon* had come still contained the pupa-skin, minus only a portion of the

head and thorax, which lay in fragments, so that the cavity of the pupal body had been the puparium of the parasite.

The pupa of *globulariæ* is about 13 mm. in length and of moderate substance throughout, with prominent thorax, the wing-covers short, but towards their ends projecting a little free from the body; the long antenna- and leg-cases are all free from the body, and seem to be suggestive of locomotion even before the disclosure of the moth; the deeply-divided abdominal rings have each on the back near their beginning a transverse ridge thickly set with hooks pointing backwards, the tip of the abdomen rounded off in a blunt point; the colour of the head, thorax, and wing-covers is dark olive-green and very glossy, the leg-cases and abdomen are of lighter shining green and the hooks black. (W. B., 12, 9, 83; E.M.M. XX, 97.)

ANTHROCERA MINOS, VAR. NUBIGENA.

Plate XVIII, fig. 4.

Through Mr. Birchall's kindness in sending me the eggs, I am enabled to give some account of the early stages of this species, but the discrepancies that exist between my account and those of other observers show how desirable it is to make further investigation.

A small batch of eggs (*small* because I could not undertake many) were received July 4th, 1867; the larvæ hatched on the 10th of the same month. Finding from the "Chapter on Minos" in the 'Entomologist's Annual' for 1862, that it was likely either *Thymus serpyllum* or *Pimpinella saxifraga* would prove to be the proper food, I procured both, but there was no doubt as to which these larvæ preferred, the *thyme* was eaten at once, whilst I could not see that the *Pimpinella* was even tasted.

These larvæ, about ten in number, grew very slowly

and were no bigger than a leaf of the wild thyme, and, indeed, of pretty much the same figure in outline, when they settled down for hybernation about the beginning of September. They assembled in two little groups of four or five each, and spinning some silk on the underside of the stoutest stems of their food-plant, rested quietly till near the end of February.

Mr. Birchall had warned me that in their native locality (the West of Ireland) they had probably little experience of frost, so I placed the flower-pot with large glass cylinder, which enclosed the plant of thyme, in a garden frame under a high wall with a south aspect; there was no hot-bed in the frame, but as it received all the rays of the sun from about 9 a.m. to 4 p.m., a considerable amount of warmth was kept up in it compared to the temperature outside. In fact, the thyme continued to grow and thicken all through the winter, until my little larvæ were quite hidden, and it would at any time have taken a sharp eye to distinguish them, whilst hybernating, from a withered thyme-leaf, so much were they of the same colour, and furnished with little hairs of the same length.

About February the 20th, 1868, I noticed four or five of them moving in the sunshine, and some of the tender shoots of the thyme showed marks of their jaws being at work; and at this date I noted down the following description :—

Length one-sixth of an inch; colour of a pinkish-brown all over; some faint traces of subdorsal rows of black and yellow spots; hairs arranged in little tufts.

On the 7th of March the larvæ sickened for moulting, and about the 14th they all appeared in a new dress. The colour immediately after the moult was a dull blackish rifle-green, the upper spots showing like black velvet, and the lower row being now distinct and of a primrose-yellow; some of the hairs were black and some whitish. As they fed and grew their colour became lighter, and about this time four of the nine

disappeared, I suppose having sickened and died, but the thyme was now so dense I could not find them.

On the 1st April the five survivors moulted again, coming out almost black, as before and gradually becoming paler till they were dark olive-green. On the 15th April they again moulted (as I have before noticed in the case of *A. trifolii*, the moult takes place by the skin splitting all along the back), and again came out darker than before.

About the end of April they had attained their largest growth, somewhat less I imagine than would have been attained in a state of nature, the heat of their position hastening their changes. They were of the usual fat, soft *Anthrocera* figure, measuring six-eighths of an inch when in motion, but only five-eighths when at rest. The colour all over was a rich, dark olive-green; the dorsal line was dirty whitish, showing broadest and palest at the commencement of each segment; on each side of it was a row of eleven black velvet round dots placed on the front of each segment from the third to the thirteenth; below this was a row of eight yellow spots on the fourth to the eleventh segments, placed on the hinder part of the segments in such a way that the yellow spot of each came just below the black dot of the segment behind it. The spiracles were black; the belly rather paler than the back. The usual dots were not visible; but each segment bore in a transverse row eight fascicles of stiff white hairs, five or six in a fascicle.

I noticed throughout their growth these larvæ moved and fed with most energy in the sunshine.

On the 2nd of May, the four larvæ I had retained began to spin, fixing themselves on the glass cylinder and not on their food-plant; two placed themselves horizontally, and the other two in a perpendicular position. The cocoons were of a glistening, dirty white; they were shorter than the cocoons of *A. trifolii* and *A. filipendulæ*, being of a more truncate form. The pupa was brown, with the wing-cases rather darker

than the body, and different individuals varied in depth of tint.

When the perfect insects (rather undersized specimens) emerged, the empty pupa cases were not left sticking in the cocoons, but had fallen down near them. I was not so fortunate as to see a moth in the act of emerging.

With Mr. Buckler's kind assistance I have drawn up a short account of the various descriptions and figures we have been able to obtain of the larva of *Minos* and its supposed varieties, from which it will be seen that the Irish larva is not quite like any hitherto recorded.

In the 'Entomologist's Annual' for 1862 there is Zeller's account of whitish larvæ on *Pimpinella*, and yellow larvæ found later on *Thymus*, also Freyer's account of yellow, white and whitish-blue larvæ, all of which ate *Pimpinella* by preference; also Hering's fuller description of the larva on *Thymus*, which comes nearer to our larva than the others, though the ground-colour is yellow instead of olive-green, and there is no mention of yellow spots. This description, however, agrees to some extent with Hübner's figure of one variety, represented by him as citron-yellow with a subdorsal row of brown spots, and a broad stripe of yellow, paler than the ground running just below them. Hübner has also figured a whitish variety with blackish spots, but placed on the *hinder* part of each segment. And lastly, Boisduval gives in his figures the ground-colour as pale yellowish or citron-green, with two black dots instead of one on each segment, and yellow spots above, not below them, a black dorsal line and some black curves above the legs. (J. H., 10, 6, 68; E.M.M. V, 73.)

Anthrocera exulans.

Plate XIX, fig. 1.

When Dr. F. Buchanan White, in company with Professor J. W. H. Traill in July, 1871, discovered this to be a British species located on a hill at Braemar, as related in vol. viii of the 'Entomologist's Monthly Magazine' (p. 68), he very kindly sent to the Rev. J. Hellins, and to me, some eggs at the beginning of August, 1871.

The larvæ hatched on the 8th of August, and in the absence of any knowledge of the nature of their food, were tried with heather and other low plants, but they chose to eat only of *Lotus corniculatus*, and throve on it, moulted once, and fed on again till the 8th of September, when they fixed themselves for hibernation; but in course of the ensuing winter they were unfortunately attacked by mould, and perished one after another, the latest in February, 1872, and I have since learned from Mr. Hellins that his examples had met with a similar fate.

Naturally enough, as time went on I hoped the full-grown larva would eventually be found, and its local food-plant ascertained with certainty, in its northern habitat, by some enterprising collector who would perhaps afford me the opportunity of figuring it; although this has not happened from Braemar, yet now, after the lapse of eleven years, I find myself in possession of sufficient materials for completing what I had, through the kindness of Dr. F. Buchanan White, so long ago begun.

For most of what follows I have been indebted to the very kind help I have had the pleasure to receive from Mr. George T. Baker, and his friend Dr. Jordan of Edgbaston, both having supplied me with numerous examples of the larva of *exulans* in different stages of

growth, together with their observations of its habits, taken in 1882 and 1883 during their summer visits to the Swiss Alps.

Two series of the larvæ of four each reached me on July 13th and 14th, and a single larva on the 16th; these were forwarded by Dr. Jordan from Zermatt, having been found by him at an altitude of about 7000 feet, at the Schwarzen See near by, feeding, while nearly buried in the tufts of the leaves of *Silene acaulis*, and often quite buried in the fleshy mass of *Cherleria sedoides* (where they seemed to have eaten out their own shape); some were also seen to be feeding on *Trifolium alpinum*, *Geum montanum*, *Sibbaldia procumbens*, and *Alchemilla alpina*.

Some of these larvæ had spun themselves up, and their cocoons got ruptured, and the half-formed pupæ had fallen out during their journey hither, while others arrived in very perfect and lively condition, from which I secured figures and descriptions. Two much smaller than the others fed but very little, and in August laid up motionless for hibernation; one of these became attacked with mould in September and died, but the smaller of the two slept safely through the autumn and winter until the 19th of April, 1883, when it began to crawl about rather feebly in quest of food; it was then supplied with a small spray of *Medicago lupulina* and a leaf of *Rumex acetosa;* the next day I could see it had partaken of both, though sparingly; afterwards it ate of *Trifolium repens* and *pratense*, lapsing occasionally into slumber until the end of the month, when it died, probably from the necessity of changing the leaves having disturbed it while waiting to moult; thus, in one state or another, all the above-mentioned died off.

In June, 1883, the same two friends were in Switzerland together, and while walking over the south side of the Great St. Bernard where some of the snow had melted (later than usual), they found hundreds of the larvæ of *exulans* feeding in the sunshine on *Silene*

acaulis and *Alchemilla alpina*, a great number of them were brought home by Mr. Baker, who most kindly sent to me on the 6th of July seven very fine larvæ in perfect condition, besides three that had already spun up in cocoons in boxes before his return, and mentioned then the apparent liking of the larvæ for water, as he had watched them closely, and seen instances of their approaching water and drinking it, and one larvæ actually crawling in a tiny pool, as though enjoying its miniature bath in the hot sunshine. This, of course, led to the experiment of my sprinkling an occasional drop or two of water over the food of four of my larvæ for a few days, but only with disastrous result, as the four water-drinkers died from an efflorescence of mould on their coats; the remaining three lived some days longer but fed very sparingly, chiefly on leguminous plants, until each in turn died, the last on the 15th of July.

On the 17th of July I bred the moth from one of the three cocoons, one only, a poor specimen and slightly crippled, yet not enough to interfere with its identification, and I hailed its appearance with great satisfaction.

Mr. Baker informed me that several of his larvæ of *exulans* spun their cocoons, but died within them unchanged, while from the few that succeeded in effecting their change to the pupa state he only obtained three moths, all dwarfed, indeed, one of them was scarcely more than half the size of a fine Swiss specimen.

Possibly such poor results, with larvæ which have the reputation of being polyphagous, may either have been from the want of their accustomed alpine plants, or may else be attributed to the great difference of climate from that of their habitat at so great an altitude in Switzerland; the elevation in the Scotch locality, though not more than half of that in Switzerland, being eleven degrees further to the north, so that, as remarked by Dr. F. Buchanan White ('Entomologist's Annual,' 1872, p. 13), the habitat of *exulans* "is

probably covered with snow from November to April each season."

The egg of *exulans* is of large size for that of the insect, and of long, cylindrical, round-ended shape, having a depression bending inwards rather irregularly on one side; the shell is very thin, and very slightly reticulated all over, in colour ochreous-yellow, changing to orange-ochreous, and finally to dark greenish slate colour, very shining from the first to the last.

When first hatched, the larva is a plump sausage-shaped little creature of yellowish olive-green colour, most minutely dotted with black, having a row of subdorsal dull orange blotches, a black shining head, the usual warts black, each with a longish rough, but pointed, black bristle, the skin rather pubescent.

After moulting, the minute dots not being so black, it appears much paler coloured, more of a drab tint showing dark subdorsal markings, but as the larva grows, when it is about three weeks old, it is dark olive-green on the back, with the sides lighter green, and it has a subdorsal row of dark brown tubercles, with a faint stripe of yellowish below them, the bristly hairs blackish-brown.

Just before it begins to hibernate about the 10th of September, it has grown to a length of nearly two lines, and is of very stout proportions, the colour dark olive-green with an interrupted black subdorsal stripe, below which at the end of each segment is a transverse oval spot of orange-yellow, the surface of the skin generally being much covered with little fascicles of black hairs.

In the following spring, after moulting, it is soon of the length of three and a half lines, and its colouring is a little fresher and darker; by the time it is from four to five lines in length, the back and sides are very dark green, and so much covered with black bristly hairs radiating from tubercular eminences as to appear blackish-green in comparison with the belly which is olive-greenish-yellow, the dorsal marking is velvety-

black, the deep yellow lateral spots enlivening the general darkness.

Towards the end of June and beginning of July it has reached its blackest stage, for it is then intensely and beautifully black, which gives additional brilliancy by force of contrast to the light greenish-yellow lateral spots; the head is black and shining, the second segment green and smooth in front, the segmental divisions when stretched out show greenish and glisten a little, but all the rest of the upper surface is thickly covered with black hairs.

The full-grown larva is from 7 to 8 lines in length, sometimes more, and nearly 3 in breadth, of elliptical figure, but with the head small and retractile within the second segment; and this also being in part retractile is twice as long as any of the others and tapering in front; the anal segment is slightly tapered and rounded off behind; all the segments are plump and cut extremely deep; the head is black and glossy, with green upper lip edged with black, the antennal papillæ whitish tipped with black; the front retractile half of the second segment is green and naked, the other half and likewise all the other segments of the body have the ground colour of the back and sides very dark green, along each side is a broken velvety-black stripe interrupted at the end of each segment beyond the second or third by a bright yellow elliptical transverse spot; each segment bears a series of ovate tubercular eminences thickly studded with short black radiating bristles, and a single long and fine hair. These almost or quite hide the green ground of the upper surface of the skin; the spiracles are black, the smooth naked belly is of a green rather less dark than that of the back; the anterior legs are black and shining with light green joints on the outer side, and light green inner surface; the ventral and anal prolegs are of a lighter green than that of the belly and semi-transparent.

The cocoon is about 7 or 8 lines in length, and from

$3\frac{1}{2}$ to 4 lines in width, somewhat fusiform, rising convexly in the middle, bluntly rounded off and rather flattened at each end to the surface on which it is spun (generally some rock or stone); it is usually very smooth, though sometimes a few slight longitudinal wrinkles are towards the front or roundest end; it is of a light pearly-greyish tint with more or less of a silvery lustre, and after the moth has escaped is semi-transparent.

The pupa is from $5\frac{1}{2}$ to $6\frac{1}{2}$ lines long, and sometimes works its way quite out of the cocoon before the moth is disclosed; it is of the usual *Anthrocera* form, with long antenna- and leg-cases, free nearly their whole length, the shortest wing-covers, with nervures in strong relief, have their margins prominent from the body, the abdomen tapers just towards the rounded-off tip, and across the back of each ring anteriorly is a narrow ridge thickly set with most minute hooks pointed backwards; the colour is blackish-green on the abdomen and all the other parts black, and with rather a dull surface. (W. B., 30, 10, 83; E.M.M. XX, 150.)

ANTHROCERA LONICERÆ.

Plate XIX, fig. 3.

Early in June, 1867, I had the pleasure to receive from my kind friend Mr. Doubleday, a dozen larvæ of this species feeding on the yellow vetchling (*Lathyrus pratensis*); they fed well for about a week, and then began to spin their cocoons,* some yellow and others white, and the perfect insects came forth from the 7th to the 16th of July.

* It seems that the *colour of the cocoon* cannot be used as a character whereby to distinguish our five-spot Burnets from our six-spot Burnets when in the pupa state.

When full grown they were nearly 1 inch in length, very plump, with the segments deeply divided, and might all be described as follows:

The body of almost uniform thickness, the head very small and retractile, black and shining; the mouth ochreous-yellow margined with black; the palpi yellow at their bases with black tips; the anterior legs black; the ventral prolegs of the ground colour of the body, a velvety bluish-green.

Longitudinally, there were subdorsal and spiracular rows of black velvety blotches, and between them at the end of each segment was a transverse pale yellow semi-transparent oblong mark.

Looking at the larva sideways, the subdorsal row of black blotches was seen to be composed of two forms in regular order on each segment, viz. anteriorly a thick oval blotch, followed after a short interval by a thinner reniform blotch. The spiracular row followed a similar order, but the blotches differed in shape, being thinner and more of a curved-wedge form, with a tendency to unite in a curve below. At the side of the belly above the feet was a fine black interrupted line. The tubercles were green and were placed on the green ground-colour in the usual order, bearing fascicles of short whitish hairs.

Specimens of the following variety were obtained when quite small on clover, by the Rev. Hallett Todd, who most kindly sent them to me on the 3rd of May. They fed up on clover and *Lotus corinculatus*, and the moths appeared from July 5th to 25th.

When full grown their green ground-colour was a little paler than in the foregoing, and rather a yellower-green; the subdorsal black blotches on each segment were anteriorly a thick, irregular, oblong blotch, inclined to be pointed above, followed after a slight interval by another similar in shape, but rather thinner below. The spiracular row was rather shorter and similar, though more pointed at the top, and meeting below by a curve from the anterior blotch; the hinder

blotch having a little tail at the bottom; above the feet was an interrupted fine black line.

The ventral prolegs were broadly ringed with black above, and their extremities tipped with black; the anterior legs black. (W. B., E.M.M. IV, 253.)

SMERINTHUS POPULI.

Plate XX, fig. 2.

I received some eggs from the Rev. J. Hellins on the 25th of June, 1882. The eggs were very large, nearly globular (some were rather more oval), smooth-shelled, of a very delicate greenish tint and glistening like so many pearls. A few days before they hatched there could be seen through the shell, what looked like two air-bubbles, and a few hours before hatching the form of this embryo larva could just be discerned of the same colour as the shell, though the latter when the larva has left it is quite clear like glass.

On the 3rd of July these eggs hatched, the larvæ eating out a hole at the side for their escape; in some instances three-fourths of the eggshells were eaten, whilst in others it was only the small portion of the shell, the removal of which furnished the hole of exit, that was devoured; the newly-hatched larvæ were of the tenderest tint of green, with *very long* caudal horns projecting from the twelfth segment.

One larva that had eaten the greater part of its egg-shell waited by the remains of the shell apparently to digest its meal, and in the meantime its long tail began to wither at the end for more than half its length, and then shrivelled and turned blackish at the point of the round portion, which eventually proved to be the tip of the caudal horn, all beyond falling away—but with the other larvæ their long tails remained without increasing in length, whilst their bodies rapidly growing made the tails appear more proportionate in length. On the 6th of July the pale yellowish oblique side

stripes were already visible, also a yellowish-subdorsal stripe, and spots on the back of the thoracic segments; the skin likewise assumed its rough character; they were already eating pieces of the entire substance of the poplar leaves.

On the 11th of July most of them had moulted the first time and were half an inch in length, and their skin was now rough with innumerable raised points; the whitish, slanting side stripes were most conspicuous on the fifth and tenth segments, that on the fifth extending to the end of the dorsal part of the sixth segment, and that on the tenth reaching to the base of the horn on the twelfth segment; these two were stouter stripes than the rest which were but thin lines.

On the 14th of July most of them had moulted the second time, and their increase in size and more bluish-green tint was remarkable; in a few hours they were three-quarters of an inch in length. On the thoracic segments were thin subdorsal and spiracular lines of whitish points, and similar spots were on the back of the second to fifth segments and along the front of the second segment, where they formed a margin; on the head also a line of white spots was to be seen down the side of each lobe from the conical crown; indeed, one may say that all the segments were roughened or shagreened with fine whitish points.

On the 19th and 20th of July some moulted a third time, others a few days later—the shagreened roughness, the increased stoutness and the fuller and yellower-green colour were at once very marked; they now grew very rapidly and they moulted the fourth time on the 27th, 28th, and 29th of July, some were then marked with crimson spots one on each segment along the subdorsal region, others had these spots only on the end of the eighth, ninth, tenth, eleventh and twelfth segments, those on the eighth and twelfth being larger than the rest; the narrow oval spiracles were whitish edged with crimson, and just in front of each spiracle was a narrow oblong crimson spot and

a similar spot behind each spiracle, and just behind each ventral proleg was a bar of yellow followed by a bar of crimson. The ground colour of these larvæ was then of a very brilliant yellowish-green, studded with rough yellow points, of which the largest and most prominent formed the slanting yellow lateral stripes, of these the two thickest passed upwards and backwards from the side of the fifth to the back of the sixth segment, and from the side of the tenth to the tip of the caudal horn, which was likewise yellow.

One larva was bluish-green, with the points and stripes quite pale yellow. (W. B., Note Book IV, 141.)

Sphinx Convolvuli.

Plate XXI, fig. 2, and Plate XXII, fig. 1.

My warm thanks are due to Mr. H. Laver, of Colchester, for the loan of a larva, and to Mr. James J. Walker, of Sheerness, for the pupa of this grand species during the autumn of 1872. Previously I had seen but the dead specimen of the larva recorded in the 'Entomologist's Monthly Magazine,' vol. V, p. 161; and it may be supposed how elated I was to have the opportunity of depicting a living example, and of noting its movements and behaviour.

The larva, which had been found in a field at Mersea, in Essex, reached me on the 24th September, 1872, continued to feed until noon of the 28th, and retired to earth on the evening of the 29th; I had therefore the pleasure of watching it for five days.

From the time of its arrival it showed no aversion to strong daylight, nor any disposition to wander away from the food supplied to it, but remained attached to *Convolvulus arvensis*, although exposed openly each day for eight or nine hours on a table near a window, with the afternoon sun frequently shining on it during that time; in all those hours its position was but little changed, merely advanced further along the stem by

slow degrees, with perhaps a turn to the right or left in order to get at the leaves in their order on the stem; so that three or four inches would represent adequately the extent of its day's progress. Another proof of its very lethargic demeanour at this stage of its growth is given by the fact, that each morning I almost invariably found it on the same part of the food-plant, and in a similar posture as when placed in its cage the previous evening; nor did it seem to be a nocturnal feeder, of which I had fair presumptive evidence by finding usually in the morning only one pellet of "frass." Throughout the day it fed frequently, taking rest in the intervals, and its meals were deliberate, never made ravenously or hurriedly, nor did it consume much at a time; the number of pellets ejected during the day was about five, and they were proportionally large.

With the view of testing if it had any inclination to hide or burrow, I placed the larva once during the daytime, and once also at night, on some fine mould, but it seemed unwilling to stay on the earth, and soon crawled up through the *Convolvulus*, which had been placed over it, and took up its position as usual on the stem of the plant.

Such were the habits of this individual on its approach to maturity, and they perfectly coincide with the account given by Mr. J. Boswell Syme, of those which he once reared (see 'Entomologist's Monthly Magazine,' vol. VII, p. 139). The opinion therefore expressed at pp. 161-2 of vol. V of that work, that this species may hide itself by day under the soil is proved to be erroneous, and my friend Mr. Hellins is very glad to be so clearly set right, on this point. Why, however, the moth should in some seasons swarm in this country to such a prodigious extent as it does, and yet the large-sized open feeding larva be so seldom found, seems strange. Boisduval says, in France the larva "is sufficiently common," feeding especially on *Convolvulus arvensis* in fields of potatoes and kidney-beans, some-

times also on *C. sepium*, and in gardens on *C. tricolor* and *Ipomœa coccinea*. And in a letter to Mr. G. C. Bignell, Mr. G. F. Mathew, R. N., mentions that in Madeira it is said to be common in gardens feeding on all sorts of *Convolvulus*, on lettuce, and other garden plants.

Potato fields in soils which *Convolvulus arvensis* affects, would seem to be the most likely hunting grounds in England; July? August and September should be the proper months in which to look for it. Boisduval, after making two grand varieties, the green and the brown, proceeds to enumerate no less than three sub-varieties under each of these heads, and then says that besides these six there are yet others to be found.

To complete my history of the individual I had the pleasure of watching, I may say that it increased slightly, though perceptibly in length and bulk, till on the fourth day it ceased to eat, became extremely restless and active, and on being supplied with soil, entered it for pupation on the evening of the fifth; unfortunately, however, it died without completing the change, the earth proving too dry and friable, for I found it had not been able to make a chamber for itself, after having gone down to a depth of two inches.

The pupa which, as mentioned by Mr. Walker ('Ent. Month. Mag.,' vol. IX, p. 162), had been found in a *potato* field, in the Isle of Sheppey, reached me on the 11th December, 1872, in lively condition, and I am glad to say it bore the journey hither and back, as well as the ordeal of sitting for its portrait, without any detriment.

The larva, when full-grown, measured exactly four inches, and in diameter five-eighths of an inch; it was cylindrical though tapering gradually from the fifth segment to the head, which was decidedly the smallest segment and flattened in front, the thirteenth also tapered a little at the end; the twelfth bore a smoothish pointed caudal horn, arching backwards over the anal

flap. The segmental divisions were deeply defined, as were also the intermediate wrinkles, which subdivided each segment of the body above into eight distinct rings, the first ring wider than the others, but none of them extending beyond the spiracles; the ventral prolegs full and stout; the anal pair large and of a squarish form; the texture of the skin was smooth, but for the most part without gloss.

The colour of the head was bright ochreous, and shining, the sutures finely outlined with black, and with two black stripes on each lobe down the side of the face; the general ground colour of the back, belly, and part of the side, was a deep blackish-brown; the bright ochreous subdorsal stripe was quite perfect on the thoracic segments, but beyond them showed only as a squarish spot on the first ring of each segment until the twelfth, where it faintly continued to the base of the caudal horn; however, its entire course was indicated plainly enough by a double row of deep brownish-ochreous longitudinal little streaks, showing on the darker ground; similar streaks of brownish-ochreous covered the rest of the back, but with a regular order and design: thus there were none on the first of the eight subdivisions of each segment, but on the other seven there was a double series converging forwards to a point near the second ring, other rows forming a broad bordering to the inconspicuous narrow black dorsal line—this line, indeed, would not be very noticeable, were it not better defined on the first ring of each segment; but it was there well relieved by being placed between two larger and paler double (often confluent) ochreous streaks. The side of each segment, between the subdorsal and spiracular regions, was divided into two triangular portions, the upper having its base on the front of the segment and its apex pointing backwards on the subdorsal stripe, and being altogether of the dark ground colour, the lower triangle having its base on the hinder part of the segment with its apex pointing forwards on the spira-

cular region, and being covered with regular transverse lines of whitish-grey dots on a brownish-grey ground; the oval black spiracles were deeply sunk each within a large rounded shining spot of blackish; the broad, whitish, inflated subspiracular stripe, was tolerably regular along the thoracic segments, but from the fifth segment it was festooned along in a puckered and tortuous course to the anal flap, followed beneath on most segments by a group of blotches and dots of a similar whiteness; the back of the second segment was glossy; the anterior legs were black and shining, also the caudal horn,* the anal flap was greyish-ochreous; the ventral and anal prolegs were of the ground colour, ringed with dull orange-red near their extremities, which were tipped with dark brown hooks; the belly had a fine ventral line rather darker than the ground, which was thickly freckled over with a paler tint of the same.

The pupa measured two inches and eleven-sixteenths in length, and five-eighths of an inch in diameter; its stout proboscis projected a quarter of an inch from the body, bent downwards at a slight angle for little more than half an inch, and then curved round upwards for half the distance towards the underside of the thorax, with which it was in contact near its blunt, rounded extremity. The various parts of the imago within were all remarkably well shown, yet gently rounded off at the prominences, the wing-covers long in proportion, the anal spike short, blunt, and roughish, the proboscis delicately corrugated or ringed. Each segment of the abdomen had on the back a narrow transverse band of roughness at its beginning, the rest of the surface smooth and shining; the colour was a light rich mahogany-brown, darker on the head, thorax and proboscis, and on the last two segments; the leg-, antenna- and wing-cases being the palest portions. (W. B., 4, 73; E.M.M. IX, 286.)

* The horn seems to vary in colour. Boisduval says "it is either fawn above and black beneath, or ferruginous, or of a rusty-red.—W. B.

Sphinx pinastri.

Plate XXII, fig. 3.

On the 26th of July, 1882, I received from Herr Ernst Heyne, of Leipzig, a dozen eggs of this species, laid loose.

These eggs were as large as those of *Smerinthus populi*, but not so round, the shape being roundish ovate; they were smooth and glossy, and their colour at the time I received them was a light greenish-ochreous-yellow, or pale olive-yellow; some were clouded within with brown, in some instances with quite dark brown at one end; the shell had a pearly lustre. Before hatching the dark lobes of the embryonic head were distinctly visible at one end.

The first egg hatched on the 29th of July; the young larva was of a light greenish-ochreous, with the two lobes of the head broadly marked with dull black-brown; the anterior legs were black, the ventral prolegs were barred outside with dark brown just above the feet, the caudal horn, which was a little flattened and slightly bifurcate at the tip, was dull brownish-black; a faint brownish dorsal line was just visible.

Another was hatched in the evening of the 31st of July, two in the evening of August 1st and three by the morning of the 2nd, two more in the evening and one at night of the same date.

After feeding for two or three days on *Pinus* ,* the body became greener and showed faintly paler green subdorsal lines and a faint yellowish spiracular line.

On the 5th of August some were laid up to moult, their skins shining green, with the front edge of the second segment pale cream colour, in striking contrast to their copper-coloured heads, marked with blackish

* The *species* of *Pinus* is not given in Mr. Buckler's note-book, a blank being left for it.—H. T. S.

on each lobe. On the 6th of August one had accomplished its first moult; its head, which was very similar in shape to that of the larva of a *Smerinthus*, was now of a pale green marked with a black streak down each lobe from the apex of the crown, their black streaks shortly afterwards were margined externally with yellow streaks, the upper lip outlined with black and the mouth black; the body was green, the back being a deeper green than the sides with subdorsal lines of whitish green, and with a fine whitish green lateral line followed by a stripe of the same deep green colour as the back, which blends a little below into a yellowish whitish-green spiracular stripe, which is abruptly contrasted beneath by the deep-green belly; the black caudal horn on the twelfth segment was of the same shape as before; all the legs as before.

By the 9th of August several of the larvæ had grown to be 14 mm. long.

On the 12th of August several had moulted the second time; the green colour was full and bright, the pale yellow lines were of about equal stoutness, the spiracular line being just the least degree the stouter, the yellow stripes on each side of the head were bright, edging the black stripes; the caudal horn was reddish-brown and glossy with the tip black, slightly bifurcate and flattened; the larvæ at this time no longer ate along the side of a needle-leaf, but attacked it from the end biting it quite through, and thus continued to munch gradually stepping backwards as it shortened the needle till the needle was consumed close up to the sheath at the twig or stem.

Between the 16th and 18th of August several of the larvæ had moulted the third time. The spiracular line was now a little interrupted at the end of each segment; the head, the anterior legs and ventral prolegs were now glossy, smooth and red, and the hinder half of the anal prolegs, anal flap and rough caudal horn were glossy, but with minute black points; the caudal horn was now curved, and viewed in profile tapered

to a rather fine point, but viewed from above was seen to be slightly forked at the blackish extremity; the spiracles were red, finely outlined with black.

Between the 26th and 29th of August most of the larvæ moulted for the fourth time, and on the last day of August and 1st of September I figured the most advanced, which was then 2 inches 5 lines in length, its proportions were slender, the head somewhat bluntly conical, the segmental divisions were rather deep, as were also the subdividing wrinkles, eight in number on each segment, beyond the thoracic segments, excepting the twelfth, which bore the rough curved caudal horn; these deep wrinkles were blackish-brown and made the segments appear like a series of rings.

The colouring and design of the larvæ were now very beautiful, the skin soft and smooth, the head, plate of second segment, the anterior legs, ventral prolegs, the hinder parts of the anal prolegs, the anal flap and the caudal horn were all as glossy as if highly varnished, and were sprinkled with raised black dots; the broadish dorsal stripe became gradually thicker towards the middle of each segment and then narrowed as gradually towards the end, the white or yellowish stripe by which it was bounded was consequently thicker at the beginning and at the end of each segment than in the middle; this was beautifully relieved by a stripe of the full and bright green ground colour, followed by another or subdorsal white stripe, which also gradually widened to the middle of each segment; below this was a broad stripe of the green ground containing a white blotch in the middle of each segment, in which was set the orange-red spiracle edged with black; close beneath this was the slightly inflated pale yellowish spiracular stripe, interrupted at the end of each segment; the belly was wholly of the green ground colour; the head was orange-reddish, more or less tinged with greenish, the deep yellow stripes at the side were bordered in front with rather dark red

and behind with deep red, the latter bordering being broader below and shading above gradually into the ochreous-green colour of the back of the head.

By the 3rd of September this larva had grown to be 3 inches and 2 lines when stretched out, and the white stripes were becoming interrupted in the middle; the front edge of the second segment next the head was of a dark-blue green, and a streak of shining reddish-black was situated in front above the base of each of the anterior legs.

On the 5th of September the larva which I had figured ceased feeding about noon and began wandering about for a little while; soon afterwards it burrowed into the earth. Another larva was at the same time very busy covering its skin all over with some fluid discharged from its mouth (reminding me of a cat licking himself); in the course of another hour this had also gone into the earth. This proceeding was within a week followed by all the other larvæ. (W. B., Note-Book IV, 147.)

Deilephila euphorbiæ.

Plate XXIII.

In 1859 I figured this species from a larva sent me by a correspondent in Jersey, but, none the less, I was desirous to see a living example again, for in the interval I knew that my eyes had been educated continually to see more and more in my subjects, and I felt I might then have passed over something in such a difficult task which I could now detect at once.

My surprise, therefore, was more than equalled by my delight when on the 7th of August, 1872, there came to me four larvæ, which a few days before had been found feeding on *Euphorbia cyparissias* in the Forest of Fontainebleau by Mr. Evan John, whose kindness in taking the pains to bring them to England as a contribution to my work I remember most gratefully.

During their journey to me they had stripped to the bare stems the food placed along with them, and appeared restless and hungry; my first precaution was to separate them and to supply them with some *Euphorbia peplus* gathered from the garden, and on this substituted food three of them began to satisfy their cravings. The largest, however, refused to touch it, and as it appeared to be full fed, I set to work at once to secure its portrait; an operation which, from the complicated nature of its details, and the irritability and restlessness of the subject, was not completed till the afternoon of the next day, when I placed the larva in a pot with sand and food, and in a few hours it spun itself up on the sand under some spurge and moss.

Meanwhile, a friend had kindly undertaken for me an expedition to the coast and had brought back a good supply of plants as well as gathered branches of *Euphorbia paralias* and *portlandica;* the plants I potted, and the branches I gave to the feeding larvæ, and it was a pleasure to witness their enjoyment of this more congenial fare.

The *Euphorbia peplus* they had been eating had evidently been regarded as a mere whet—and their appetite now seemed insatiable; each larva embraced the sea-spurge with all its legs, and ate voraciously, and at length when compelled to stop, it would go to sleep without change of position, and with a partly-devoured leaf in its jaws; and then, after a few minutes' repose, it would wake up, finish the leaf, and attack whatever came next—leaves or seed-vessels—most vigorously; there was no walking about, the only movement was a step or two backward as the stem shortened beneath its jaws.

From this time their behaviour was most satisfactory. Fortunately they were all of different ages, though all in their last moult, and I was able, without anxiety for the others, to devote my whole energies to one at a time; and so in turn they all sat to me—or rather I may say ate before me—during eight days while I

was closely at work, and never sulked or shrank when the sun shone on them, or when for closer inspection I took them in my hand; only as each matured, and ceased feeding, it grew active and lively, and exhibited its capacity of walking at a great pace for a day or two before settling down to its change.

The smallest of the four had apparently just undergone its last moult when it reached me, and it was then just one inch and a quarter in length; the dates for their making up were respectively August 8th, 14th, 17th and 18th. The earliest pupa was figured on the 21st of October, when on searching for the others, the latest larva was found to have died without turning, although it had made a perfect cocoon.

Emboldened by a former success in forcing several *Deilephila galii* to perfection in 1870-71, I resolved to hazard the three pupæ of *euphorbiæ* in a similar experiment.

On the evening of the day in which I had disturbed them, I packed them in the forcing box with moss and placed them at first on the iron plate of a kitchen stove over the boiler; here the situation was warm through the greater part of the night and quite hot by day, when the bottom of the box was elevated two inches above the hot plate by the aid of two strips of wood on which the box rested; here they were damped with lukewarm water twice a day. On the 23rd of November a fine and perfect moth came from the earliest pupa, but after that my efforts were baffled; the two remaining pupæ continued lively but the moths would not appear. I moved the box to a place before my sitting-room fire, but without effect; and at last I came to the conclusion *I ought not to have begun the forcing till the weather had become dry and frosty;* then the heat would have had due effect, but as it was, the great humidity of the atmosphere had prevented this, and sufficient heat had not reached the pupæ to develop the imago in them at once.

After continuing my forcing till the end of December,

I put the pupæ aside to wait for summer, but before that time came they had died.

Of course I can say nothing of the larva when young, but I may notice the appearance of the two smaller ones when they first came to me. The ground colour of the smallest was black; the next in size was blackish-green, with a multitude of small bright yellow dots, contrasted with larger spots of yellow tinged with a rosy hue in the centre; for the rest I shall describe one full-grown larva, and mention the variations of detail in the others, as each preserved its individual points of difference to the last.

The full-grown larva measured from three to three and a quarter inches in length, being in proportion a trifle more slender than the larva of *D. galii*, though otherwise similar in form, being plump and cylindrical, tapering considerably from the fourth segment to the head, which is the smallest segment, and is rounded in outline; tapering a little also at the two hinder segments, the twelfth having a rough, blunt-tipped horn curving a little backwards; each segment from the fifth to the twelfth is subdivided into seven rings by well-defined wrinkles, the front ring being equal in width to three or four of the others. The skin was generally smooth and shining; the anal prolegs larger than the ventral prolegs and of a squarish form; the segments appeared more plump and swelling on the ventral than on the dorsal surface.

As to colour, no two individuals were of the same type, the ground colour of the skin only varying in intensity from a bronze-green to a deeper blackish-bronze. The head was blood-red, the mouth and base of papillæ pale yellow, the former margined above and below, and the latter surrounded with black; the dorsal stripe was blood-red in colour, widening on the second segment in a curve down either side, suggestive of a plate, but thence continuing of nearly uniform width to the anal flap, which was likewise red. The horn

was of the same colour but glistening and with the tip black.

In these larvæ the subdorsal region bore a row of very blunt wedge-shaped red marks, widest at the hinder part, and pointing forwards, and a row of large roundish or dumpy pear-shaped bright ochreous-yellow spots slightly tinged above with pink (on the twelfth segment of a longer pear-shape, with the stem pointing to the horn); below these was another similar row, only paler and irregular in shape from a fold in the skin, these spots on each broad front ring being much surrounded with black; below these were a few small white dots, and then the whitish oval spiracle; the narrower hinder rings of each segment—whether in the red wedges or on the ground colour—bore transverse rows of thickly-set yellow dots; the puffed region below the spiracles showed red interruptedly, but without any dots; beneath this was a patch of the dark ground colour sprinkled with white dots; the tips of the ventral and anal prolegs were blood-red; the anterior legs were orange-ochreous tipped with black.

The variety which may be termed the *red* variety, from the great quantity of this colour which it possessed, had the first or broad ring of each segment of a black ground colour, and the narrow rings of a bronzy-green; the wedge shapes of red in the subdorsal region extended along each segment from their greatest breadth at the last ring to the blunt apex close to the broad front ring; the dots of yellow above and whitish below, and the double series of large spots were as described above; all the rings were abruptly interrupted by the inflated and rather tortuous broad subspiracular region coloured red; below this on each segment came a pear-shaped patch of bronzy-green dotted with white; all the rest of the belly and legs were red, but inclining at the segmental divisions to deep ochreous or greenish-ochreous, as the above-mentioned red wedge marks also did at the same place. There were a few yellow dots at the segmental

divisions in the subspiracular region; the black plate on the second segment was margined with red; the red head and the dorsal stripe, &c., were as in the other varieties.

The *black* variety had no subdorsal wedge marks; the first ring in each segment had a black ground, the others a greenish-black ground, dotted and spotted with bright sulphur-yellow above, and white below; very little of the subspiracular region was inflated, it was coloured crimson-red and ochreous, the red in the middle gently blending with the ochreous at each segmental division; the anterior edge of the second segment was yellow, a large round black spot on the top of each lobe of the crimson head. The anterior half of the anal prolegs was black, the rest crimson; the crimson dorsal stripe quite narrow; the anal flap was black margined with crimson.

I must not omit to mention a handsome variety of this larva, brought home in spirits from Cairo by Mr. Jenner Fust, which I thankfully received in May, 1871, through my friend Mr. Hellins and figured. This had the broad ring on each segment black, the ground colour of the others of the deepest blackish-olive, the head, the plate on the second segment, the dorsal stripe, the legs, anal flap and caudal horn, were blood-red. The double series of large spots were creamy-whitish; the upper rows of small dots pale yellow, the lower rows white; the subdorsal truncated-wedge shapes were of deep ochreous and largely developed; the inflated subspiracular region, belly and ventral prolegs, of deep ochreous or buff colour, the latter tipped with red; a pear-shaped blotch of dark olive dotted with white was situated below the subspiracular region on each segment; the anterior legs red.

The cocoons were of a very firm texture, spun with strong and coarse silk threads attached to some leaves of spurge above and with some sand interwoven, and in each instance firmly fastened to the side of the pot, and sunk about half an inch below the surface of the

sand, so that they were immoveable, though the sand was loose. The interior of the cocoons beautifully smooth, with fine silken lining.

The pupa was one and five-eighths of an inch in length, and half an inch in diameter, tapering a little from the thorax to the frontal extremity, where it was rather smooth; the wing-cases pressed close to the body; the abdominal rings in tolerable relief; the outline tapered a little near the anal tip, which ended in a broad, flattish, downward-curved spike, pointed at its extremity.

The colour was a dingy, deep brick-red above, fading a little beneath to more of a flesh colour, and thickly covered with minute blackish punctures. The wing-covers were dark brownish, much freckled and finely streaked with blackish, as were also the head-, antenna-, eye- and leg-cases, as well as the trunk-case. The segmental divisions of the abdomen were dull purplish-red, and quite smooth, while the parts between them were roughened by black pits or punctures on a rather shining ground; a dorsal line of the ground colour was visible on the back of the thorax. The spiracles were black. (W. B., 13, 5, 74, E.M.M. XI, 73.)

Deilephila galii.

Plate XXIV.

Till the autumn of 1870 it had been my chance to have seen but one larva of this species, and that a dead one, as long ago as 1859. This defunct larva I carefully figured, but, as may well be supposed, I could never feel satisfied that my figure was at all trustworthy.

The satisfaction and the feverish delight I experienced in the autumn of 1870 by the gift of four, and the loan of not less than twelve, larvæ in various stages of growth, may be better conceived than described

To Mr. Nicholas Cooke and Mr. Henry Terry my warmest thanks are due for this great kindness, of which I availed myself so far as to take fifteen figures and to put together the following observations.

The larvæ reached me at intervals from the 6th to the 26th of September, 1870, and fed freely on the flowers, unripe seeds, and leaves of *Galium verum*, and occasionally ate a little *Fuchsia*. When full-fed they were restless, and wandered about for a day or two before they settled down to spin. They made for their covering a rather coarse network of threads, which bound the sand beneath them with the *Galium* above into a slight cocoon, and they had all retired by the 8th of October.

In form these larvæ reminded me of some of the *Chœrocampæ;* for, although the thoracic segments are but slightly retractile, yet they are tapered off rapidly to the head, which is rounded and smaller than the second segment; the rest of the body is tolerably cylindrical, just a little thickest in the middle segments and rather less bulky behind, the anal prolegs being broad and squarely developed; the caudal horn is curved backwards, its point arching over the anal flap, and it is rough, with minute bristly points.

Each segment of the body, excepting the thoracic and posterior segments, has a very broad subdivision in front on the back, followed by six narrow ones, though whilst the larva is very young the two hinder folds are united into a broader one, the last wrinkle being smoothed out; these wrinkles or folds extend as low as the spiracles. Just in the spiracular region there is a longitudinal, somewhat puckered inflation, but marked only by dimples when the creature is in repose. A few very short bristly hairs fringe the prolegs.

With regard to colour, I propose to describe the changes that occurred in the smallest of six young larvæ up to its adult state, before speaking of varieties.

This larva, then, on its arrival, was about three-

quarters of an inch in length, of a rather bright, full, opaque green, the belly and legs a little paler than the back and sides, with dorsal, subdorsal, and subspiracular stripes of pale ochreous-yellow. Upon the subdorsal stripe on the front of each segment appeared an indication of an oval spot of a little deeper yellow, with the faintest possible outline above of black; the horn at this time but slightly curved, semi-transparent, and of a reddish tint tipped with crimson; the hinder wrinkled portions of the segments dimly showing some whitish-green freckles.

On moulting it changed into a deeper, brighter, and purer opaque green dress, in which the previous design was further developed. The green on the back was now deeper than that of the side, and the belly and legs a little paler still. On the subdorsal stripe at the beginning of each segment the oval spots were enlarged and tinged with bright orange, edged above and below with black; the end of the stripe towards the horn bore something of an elongate pear-shaped spot. A freckling of pale yellow specks distinctly appeared on the hinder portions of each segment as well as on the sides; the spiracles white, outlined with black; the head pale bluish-green, marked with black near the mouth; a pale bluish-green plate on the second segment; hinder extremities pale green, slightly tinged with pink; the horn pinkish-ochreous, tipped with deep crimson.

When a length of an inch and a quarter or thereabouts is attained the final moult takes place, and a great change is at once apparent; the *stripes* have totally disappeared, and the head, the plate on the second segment, with the anal flap and prolegs, show purplish-red. In the individual whose changes I have been tracing the ground colour at first was opaque-black, relieved only by the pale yellow subdorsal spots, a few small freckles and the spiracles; but investigation with a lens disclosed an infinity of little puckers and wrinkles, reminding one of the texture of crape. By

degrees these wrinkles were smoothed out as the creature grew, and the final dress was assumed.

I shall now describe this same larva when mature, and then give notes of the chief varieties which came under my notice.

Length, when stretched out, two inches and seven-eighths. The back and sides of deep bronzy olive-green, but below the spiracles and on the ventral surface the colour is a smoky deep purplish-pink; although the boundary is clearly defined, yet a gleam of the one colour tinges almost imperceptibly the other, both above and below.

There is no subdorsal line, but in its place a row of fourteen somewhat roundish spots; four of them on the thoracic segments are small, the others large, the hinder one somewhat pear-shaped, pale golden-yellow in colour, and set in transverse ovals of deep black, which melt into the ground colour; the spiracles yellow, outlined with black, and surrounded by a cloud of darker olive than the ground colour; a few small yellow specks are sprinkled along the sides. One can well make out a thin dorsal stripe of deep ochreous-olive, wide at the beginning of each segment, looking as if it were showing dimly through the surface from a depth below. The head is purplish-pink, the mouth black, with a streak of pale yellow above it and yellow bases to the papillæ, and just above them is a narrow circumferent band of black. The plate on the second segment, the anal flap, and the prolegs are dark pinkish-red; the anterior legs black, the ventral prolegs purplish-pink, with an outward bar of black near their extremities; the horn is semi-translucent and blood-red; the whole surface of the skin, excepting on the thoracic segments, is now brilliantly polished, and resplendent with the play of light at every movement.

Taking the above as my type, I could make two grand varieties as to ground colour—the pale olive and the black; and each of these—as well also as my

dark olive type—furnished a further subdivision through variation in points of detail.

Var. 1.—Neither a light nor a dark olive-green, but between them, with the large yellow spots developed into pear shapes, the small end of each projecting forwards as a spot on the segment in advance.

Var. 2.—Dark reddish-brown, with just a tinge of olive, and with the addition to the usual obscure dim dorsal line of a bright pale ochreous mark at the beginning of each segment, terminating at the end of the broad first subdivision, which appears like a black band; the bright yellow subdorsal spots as before.

Var. 3.—The ground colour of the back and sides a pale brownish ochreous-olive; the subdorsal pale primrose-yellow spots, and the spiracles environed with black; the belly and prolegs rose-pink.

Var. 4.—A deep jet-black on the anterior segments, bluish-black on the others; the head, thoracic plate, and anal extremities of very dark purplish-red; the subdorsal spots of a dirty and dingy yellowish-drab tint, with their centres more or less filled up with blackish-brown, in one or two instances wholly obliterated.

Var. 5.—Ground colour entirely bluish-black, the deepest tinge of purplish-red on the head, the plate behind, and the anal extremities; blotches appear on the side of the anal flap, which, with the subdorsal spots, the spiracles, and an extensive irroration of small dots, are all of the purest pale golden-yellow, the black ground being left unbroken as a band across the back from one subdorsal spot to the other.

Concluding my own remarks, I may state that in every instance the skin after the last moult was black for a day or two, as previously mentioned; but at this time one may judge of the colour the larva will eventually assume, by the tint of the head, thoracic plate, and anal extremities; these parts, if then quite black, indicate that the ground colour will be black to the end of its career; but if they are of deep purplish-red,

the larva will turn to a dark olive or brown; or should they be of a bluish-green slightly tinged with pink, a pale olive larva will result.

So far, I have put down only what I have myself seen in the living larvæ, but I may state that amongst some figures most kindly lent me by Mr. Boswell Syme, there was one of a black variety, with the sub-dorsal spots of a dull crimson colour.

Mr. Boswell Syme has had altogether about 200 larvæ, and says "head always red," whilst Stainton, in his notes made from living larvæ, says "head pale greenish," with the memorandum that Sepp's figure came nearest to his specimens.

The pupa I examined was one inch and five-eighths long, including the short, curved horn or anal spike, and moderately stout; the head rounded and narrower than the thorax, the anal extremity a little tapered but otherwise tolerably uniform in bulk; the wing-cases were close to the body, and extended as far as the eighth abdominal segment; the last five segments were rather deeply cut and flexible, the sides of the incisions smooth, all the other surface granulous.

Its ground colour was a deep red, and this was much suffused or sprinkled with black, especially on the wing-, antenna- and trunk-cases, also on the back of the thorax; this last had, however, a dorsal line, and the pieces of the thorax were outlined with the ground colour; the antenna-cases and the ends of the wing-cases were relieved by a fine marginal streak of flesh-colour; the smooth sides of the abdominal incisions were deep and rather purplish-red; the spiracles blackish-brown. (W. B., 12, 10, 70; E.M.M. VII, 123.)

Deilephila livornica.

Plate XXV, fig. 1.

On the 11th of July, 1870, a labourer brought me a beautiful larva, which he had found in a mangold-wurzel field near Exeter; I offered it *Galium saxatile*, vine leaves and *Fuchsia*, and it immediately attacked the last with great avidity.

My first impulse was to call it *livornica*, but the description I consulted under that name did not suit; the points laid down in them as distinctive characters I could not find,* hence I concluded that my prize was *galii*, and under that name recorded its occurrence in the 'Entomologist's Monthly Magazine,' VII, 61.

The larva fortunately soon spun up, and resulted in *Deilephila livornica* ♀, which emerged on the 18th of August.

The following is a description of this larva made with Mr. Buckler's good help; to this I append some notes communicated to me of other larvæ found in Devon and Cornwall.

The length of the larva when stretched out is about three inches and a half; the head is the smallest segment, the body tapering towards it from the fifth segment; the anal prolegs broad and square, *the horn slightly curved, blunt at the tip*, and rough; the skin rather shining, but on the hinder half of each segment showing seven folds well defined at the sides, but not so distinct on the back, where the skin seems tighter.

The ground colour of the back and sides, as far as the spiracles, is an intensely dark green; the head black, but with a streak across the mouth, as well as the base of the papillæ, lemon-yellow; the plate on the second segment black; an ochreous-yellow dorsal stripe commences on the third segment and is continued to the horn, it is suffused with rose-pink, and

* In saying this I was wrong; the anal horn ought to have shown me what the species was.—J. H., 24, 3, 86.

is bordered for some little width on each side by the plain ground colour. A sort of transverse band, also of the ground colour, is placed on the front of each segment, extending from the dorsal line to below the subdorsal; the rest of the side is irrorated with small greenish-yellow spots which become more whitish near the spiracles. On the lower ends of the above-mentioned bands on segments 4 to 12, and just in the region of the well-defined, greenish-yellow, freckled, subdorsal line (in fact, strung on it like beads on a string), is a row of nine large, roundish, lemon-yellow spots tinged in the upper part with pink; these are made all the more conspicuous from being delicately bordered with black, and have also two largish spots of black on their upper border. On segment 3 there is no spot, but only the subdorsal line. The spiracles are ochreous yellow, tinged with pink; just below them is an inflated and puckered stripe, yellow on the second segment but whitish on all the rest, and interrupted just behind the middle of each segment by a large round spot of pink, slightly tinged with olive; the belly also pinkish; the anterior legs black; the ventral prolegs pinkish-white, tipped in front with a spot of black; the anal prolegs black, a pink edge at the side of the anal flap. I have called the subdorsal spots roundish, but in reality the shape is somewhat that of a dumpy pear with the short stem pointing forwards and upwards, whilst the last spot in the row, that on segment 12, may be described as of an elongated pear-shape, with the point directed backwards and upwards towards the horn.

Unfortunately I did not examine the pupa with a view to description, but I saw that it was long, of a light brown colour, with the last two segments darker brown, the anal spike strong and sharply pointed, but with no other projection to break the outline. It was placed on the surface of the earth, and the cocoon was but slight, being formed of a few bits of earth and withered fuchsia flowers just tacked together with

a few silken threads, many interstices being left, through which the pupa could be seen. The following notes of a larva taken by Mr. L. Cumming, near the Lizard, Cornwall, have been kindly furnished me by Mr. W. C. Marshall :

"The head and second segment and the anal prolegs all deep pink; the dorsal line yellow; the horn red and rough; the ground colour dark green freckled with yellow, save in the transverse bands on the front of each segment; the subdorsal line yellow, but without the row of roundish spots; the belly yellowish."

This seems the palest specimen I have heard of. Nearest to it, and, in fact, intermediate between it and my Exeter larva, comes one captured near Plymouth, and described and figured by Mr. G. C. Bignell.

"The head and second segment dull pink; the dorsal line yellow; the ground colour blackish, much freckled with yellow; the subdorsal line yellow; the subdorsal row of spots yellow with pink centres; the anal prolegs dull pink, the belly whitish-yellow, the horn red, tipped with black, and rough."

Another larva, described to me by Mr. J. Gatcombe, was much darker, and must have come near to Fuessly's description quoted in Stainton's 'Manual;' it had the head of the second segment black, an intensely black stripe all down the back, the transverse bands black, and enclosing at their extremities semilunar spots of yellowish-white on the subdorsal line; the pinkish suffusion of the round spots being in this case replaced by black, and so the usual outline of the spots was altered; the rest of the back and sides blackish, irrorated with greenish-drab; the belly also very dark, the horn dark purplish.

Boisduval calls the larva "*polyphage*," as it indeed appears to be. I have heard of six specimens taken on a vine. Mr. Cumming's larva was found on dock. Mr. Bignell's was figured on knot-grass. Mine ate fuchsia greedily, although the rustic who brought it to me in his neckerchief assured me he found it among

mangolds, and that it ate grass after he had carefully wrapped it up. (J. H., 8, 9, 70; E.M.M. VII, 99.)

Trochilium chrysidiforme.

Plate XXVII, fig. 3.

On the 19th of August, 1880, I received from Mr. W. R. Jeffrey five eggs laid by an unimpregnated ♀ of this species. These were the first eggs I had seen of any of this genus. The egg was comparatively large for the size of the moth, of a broad oval shape, flattened, and with a hollow longitudinal depression above and below (that is, on both sides of the flattened egg); the surface was apparently smooth and shining; it was of a very dark purple-brown colour. (W. B., Note Book II, 27.)

On the 5th of July, 1866, I received from Mr. Meek the larva of this species feeding in the roots of *Rumex acetosa* and some other kind of *Rumex*, he having observed and followed a female moth and seen her deposit her eggs on several of the above plants; with great sagacity he followed up his discovery by detecting the larvæ, one of which I have now the pleasure to describe.

This larva had mined in the thickest portion, and rather on one side of the root; it had ejected heaps of brown "frass" at both ends of the mine, and had spun a tough brown silken covering over a portion of the side which had been eaten quite through; this and the "frass" were good indications of the tenant within.

The larva was from five-eighths to three-quarters of an inch in length, tapering a very little posteriorly; the head was rather broad and slightly flattened; the body rather pellucid, smooth, plump and shining.

In colour it was of a dirty brownish-white, with the dorsal vessel showing through as a dark grey internal

pulsating streak, and visible as far down as the beginning of the tenth segment. The head was rather reddish-brown, with a narrow plate of the same colour on the second segment; the anal segment had a yellowish plate; above the spiracles were some very minute blackish punctures. (W. B., 7, 66; E.M.M. IV, 14.)

Trochilium ichneumoniforme.

Plate XXVII, fig. 4.

The larva of this species had till recently baffled the researches of entomologists, both British and foreign, but has eventually been detected by the exertions of Mr. Meek; thus being the second clear-wing larva which he has discovered.

On the 26th July, 1869, Mr. Meek sent me a larva of *T. ichneumoniforme*, and subsequently a pupa, with the mines of both in the main roots of *Lotus corniculatus*.

Its habit seemed to be to scoop out a groove or hollow channel along the side of the root, covering its back evenly with the gnawings or *débris* of "frass," spun together with silk, not projecting as an excrescence, but with the outline of the root preserved. When present it may, however, be readily seen when sought for, as the external covering of its mine is of a pale brownish-yellow sawdust tint and texture, forming a strong contrast to the dark grey-brown colour of the rind of the root.

The larva was about half an inch long, rather thick in proportion to its length, with the head less flattened than usual in this genus, and the body rounded, plump and full. The second segment was the longest, and the third and fourth were rather thicker than the others, with puffed or swollen subdivisions; the remaining segments had rather an

overlapping tendency, and the three hinder ones tapered gradually.

The head was pale brownish-flesh colour, with three broad stripes of brown down each lobe and with a triangular brown patch between them; the mouth was blackish-brown.

The second segment had a semi-transparent polished plate of flesh colour, through which could be faintly seen the back parts of the head slightly tinged with brown. All the other segments were of a uniform pale yellowish-flesh colour, rather opaque, with a slight trace visible here and there of a darker dorsal vessel. The tubercles were not raised, but the situation of each of them was indicated by a very fine pale brown hair. The spiracles were flesh coloured, outlined with brown; the prolegs the same as the body; the anterior legs pale brown.

The pupa was about three-eighths of an inch long and rather flattened beneath, arched upwards rather suddenly from the sharp beaked point at the head, and rounded on the back. The abdomen at its junction with the thorax was depressed at the sides, it gradually widened for about half its length, and then tapered towards the anal extremity, which was rather truncated. The abdominal rings had a series of minute covered hooks at their edges. The wing- and antenna-cases were remarkably long, extending nearly to the end of the abdomen. The eyes were black, large, and projecting; all the other parts were of a shining bronzy-brown. (W. B., 12, 8, 69, E.M.M. VI, 90.)

Trochilium cynipiforme.

Plate XXVII, fig. 5.

Received through Mr. Hellins from Dr. Algernon Chapman a larva feeding in bark of oak, which was in a sound state though attached to a stump quite rotten.

The larva was about seven-eighths of an inch in length; it had the head flattened and smaller than the second segment; the body was cylindrical, but tapering a little posteriorly, especially the anal segment; it was somewhat plump, with the segmental folds rather deeply incised. The colour of the body was a rather opaque yellowish flesh colour, with a faint indication of a dorsal vessel showing through on the last four segments.

The head was dark purplish-brown, with the mouth blackish, above which in the middle was a flesh-coloured spot. There was a shining brown plate on the second segment, and a pale yellowish-brown one on the flap of the anal segment; the tubercles were very minute, each bearing a short brown bristle; the spiracles were also exceedingly small, being dark brown ovals with flesh-coloured centres.

A further supply came from Dr. Chapman, November 10th to 21st. The perfect insects from the larvæ appeared June 29th to July 1st, 1869, viz. 2 ♂ and 1 ♀.

The pupa of *T. cynipiforme* was about half an inch in length, moderately slender, and tapering to the anal extremity, with the abdominal segments rather deeply divided, the tips of the wing-cases and antenna-cases projecting a little from the body and sides.

On the back of the abdominal segments were two slightly raised ridges, distant from each other about the width of a segmental division; these ridges bear small, short, sharp, recurved hooks pointing backwards; on the three last segments these hooks were rather larger and only in a single row; the anal extremity was rounded at the very tip and had six short spiky hooks encircling it.

The pupa was brown, with the hooks blackish, the entire surface very shining. It was enclosed in a slight silken-lined cocoon formed of "frass" and the gnawings of the bark very slightly spun together.

A short time before the perfect insects emerged

these pupæ obtruded themselves from their cocoons so far as to leave only the three hinder segments within them. (W. B., Note Book II, 21.)

Trochilium sphegiforme.

Plate XXVIII, fig. 1.

On the 17th June, 1867, I received from Mr. Charles Tester, of Sherlock's Farm, Balcombe, a full-grown larva of this species, which he had found burrowing in the stem of an alder tree.

This larva was about an inch in length; its flattened head was of a purplish red-brown colour; the second segment, which was very much larger than any other, bore a shining plate outlined with brown; there was also a shining ochreous plate on the anal segment. The body was of a pale yellowish flesh colour, with the dorsal vessel indistinctly seen through the semi-transparent skin. The spiracles were brown but not very distinctly visible, and there were a few short fine hairs in the usual situations. (W. B., Note Book II, 22.)

Trochilium tipuliforme.

Plate XXVIII, fig. 3.

This occurs in the stems of black currant, and sometimes in those of red currant. A larva I found on the 22nd of March, 1869, was full grown; it was three-quarters of an inch long; the head brownish-red, the back of the second segment highly lustrous and pellucid (generally tinged with red), showing the margins of the head lobes through it. The colour of the body was rather an opaque yellowish flesh colour, the ordinary tubercular warts transversely oval and shining, but with a polish not quite equal to that

of the second segment, each bore a minute brown bristle; a few hairs issued from the head and anal tip, but were not visible to the naked eye. The spiracular region was an inflated ridge but not prominent, the spiracles *very small* and black, the tip of anal segment pale yellowish-red. The warts rather large in proportion. The body had the appearance of ground glass, the warts had less the appearance of ground glass, and the second segment of clear glass.

Of the two larvæ I received from Mr. Marsden, of Gloucester, one was three parts grown and showed the dorsal vessel, but the other, which was full grown, had hardly a trace of a dorsal vessel and that only behind.

Previous to pupation the larva gnaws the side of the stem at an acute angle, and penetrates all but the external rind, of which there remains only the thinnest possible film; it then spins a slight silken covering attached to the sawdust-like "frass" around, and it is then ready for the pupal change and afterwards for final transformation. (W. B., Note Book II, 8.)

Trochilium philanthiforme.

Plate XXIX, fig. 4.

On the 7th of June, 1879, I received from Mr. Edwin Birchall, then in the Isle of Man, several little sods of *Statice armeria*, containing pupæ of this species, and in the morning of July 25th a male and a female emerged both perfect specimens.

Mr. Birchall had kindly drawn my attention to the fact that they jump backwards, and this is always their first motion before attempting flight. This I already noticed when attempting to box them. The same habit also occurs in *T. scoliæforme*.

On the 24th of August, 1879, I received from Mr. Birchall some tufts of *Statice armeria* containing

examples of the very curious puparium constructed by the larva sometimes; apparently more frequently the larva pupates within the tuft of the food-plant, and when the insect is about to emerge the pupa make its way upwards, through the silk-lined excavated passage, which is continued upwards from the bottom through the solid materials of the tuft, and the pupa protrudes itself free from the tuft excepting only the last segment, which is sufficient to sustain it from falling; it was in this manner that both my moths were disclosed.

In the other instances the larva constructs a silk tube or gallery covered externally with grains of "frass" of the same dingy hue as the tuft, from which it projects to the length of an inch or even two inches; sometimes this projecting tube will stand out from the tuft almost perpendicularly, at other times it is at a considerable angle or even in a horizontal position; towards the extremity it is generally rounded off rather abruptly. The diameter of this tube at the end is about three-sixteenths of an inch, frequently a little less near the base within the tuft, from which it springs; this tube is not always quite straight, but is sometimes a trifle tortuous.

It is within this tube that the larva sometimes undergoes its change to the pupa state; in one which I opened the pupa was lying very near the top. Another one was empty, there being a hole at the top through which the pupa had pushed itself for the escape of the moth.

The pupa was half an inch long, not very stout, and tapering gradually to the anal end; the head was rather pointed, the eye-covers distinct and large, the thorax arched and full; the wing-cases were of moderate length and wrapped close to the body; the antenna- and leg-cases long, a portion of the latter projecting free from the body. The abdominal segments were well incised, each having on the dorsal surface two transverse ridges, of which the anterior ridge was

the more distinct, the other being only very slight. On the segments nearer the thorax these ridges are but slight, but they gradually become sharper on each following segment to the last, and in like manner the size and length of the hooks which point backwards, with which the ridges are armed; the abdominal tip has a circlet of about eight still stouter hooks.

The pupa was of a light reddish-brown colour, except the thorax, eye-covers, and parts of the wing-cases which were dark brown, the hooks were black; the whole surface was rather shining.

Hepialus hectus.

Plate XXX, fig. 1.

To the very arduous, long-continued, and valuable exertions of Mr. Joseph Steele, of Congleton, in elucidating the history of this species, I am deeply indebted.

The eggs are globular, small, and bluish-black,* and are laid by the ♀ over fern brakes towards the end of June. The young larva is hatched about the middle of July, and is then of a drab colour, with brown head, and plates on the second and anal segments, and, with the aid of a lens, the hairs on its body are easily seen.

It burrows in the lower part of the stem and feeds in the root of *Pteris aquilina*, and grows but slowly its first season. When a year old it makes good progress, and by or before the end of its second autumn it has apparently attained its full dimensions; it then ceases to feed and quits the root, not, however, going beyond two or three inches from it, and there in the earth remains dormant until the following spring.

In April it recommences feeding, and continues to about the end of May or beginning of June, according to the locality and season, though not feeding in the root as before, but attacking the young shoots of the

* The eggs are white at first, but soon turn bluish-black.—J. H.

fern. The parts bitten are oval excavations, about five or six lines long, in a vertical direction, and from two to three lines broad, and hence considerable exudation of sap ensues, which probably forms part of the sustenance of the larva, as at this time it is found quite wet, and the stem and soil are even saturated.

At the end of May or early in June it is full-fed, leaves the fern, and just on the surface of the earth, amongst dead leaves, and often under moss, spins an oblong cocoon, lined with silk, and covered with light vegetable or earthy matter. It remains but a short time in the pupa state, as the perfect insect is disclosed during the month of June.

The full-grown larva is about an inch and one-eighth in length, cylindrical, slender, and tapering a little towards the head, and also just towards the anal extremity; the head being broad in front and rather flattened, the sides rounded.

The transverse wrinkles on the segments beyond the fourth are so regularly and uniformly indented, that the segmental divisions cannot well be distinguished from them, the body appearing like a series of rings, each segment being subdivided into four, the second in front being the widest, and the rest of equal width.

Its colour is a pale drab—more or less pale in individuals—and opaque, becoming only a little transparent and shining on the thoracic segments, which are furnished with brilliantly-polished plates or horny markings in the following order: A black or blackish-brown plate, rounded behind, covering the upper surface of the second segment; the third and fourth have each a transverse dorsal, narrow oblong plate in front, and a very small one on each side below it, and a little farther back, on each side, is a drop-shaped plate, and just above the legs an oval or circular one; all of these plates, besides one on the tip of the anal flap, are dark brown, as also is the head, and highly lustrous, contrasting with the dull appearance of the rest of the body.

The tubercular blackish dots are very small, each emitting a fine hair of great sensitiveness. The spiracles very small and black.

It is extremely difficult to inspect the larva carefully, as it evinces the greatest aversion to light, and makes rapid efforts to hide itself. At such times if one of its hairs be touched with a finger, most violent contortions ensue, or else it springs backwards, and will run that way quite as rapidly as forwards, and in its twistings and wrigglings it rivals the most nimble of *Tortrices*.

The pupa is about five-eighths of an inch or little more in length, very slender and of about uniform bulk throughout; the head and back of thorax a little prominent, the abdomen slightly curved backwards, long, and scarcely tapering at the end, which is obtusely rounded. The wing-cases are very short in proportion.

On the back of each abdominal ring are two transverse ridges of minute curved points or hooks, and a pair of them on the under surface of each ring, the penultimate having a ridge of them in addition, and a circlet of them on the blunt and rounded tip.

The colour of the pupa is rather dark brown, but the golden blotches begin to appear through the wing-covers, and increase in brightness as the hour draws near for the disclosure of the imago, the pupa previously making its way nearly out of the cocoon in readiness. The moths bred were all out from the 26th of June to 6th of July. (W.B., 68; E.M.M. V, 177.)

HEPIALUS VELLEDA.

Plate XXX, fig. 4.

It is with a feeling of great thankfulness to Mr. Joseph Steele, of Congleton, that I am able, through his untiring exertions, to bring to light the history of this species.

The eggs were scattered by the parent moth on the

ground amongst the stems of fern (*Pteris aquilina*) during the month of June. The egg is globular and of a pale drab colour, which in a few hours changes to a deep blue-black.

The young larva is hatched in three weeks; it is then of a drab colour, with pale reddish-brown horny head, plates and spots, and distinctly visible hairs. It immediately begins burrowing into the earth by the side of the fern stems, nibbling them in its progress downwards to the root or rhizome of the fern, from which its future sustenance is to be derived during two seasons.

By the end of the first twelve months of its existence the larva has attained the average length of three-quarters of an inch, and is very slender and active, of an opaque yellowish- or greyish-white, with three transverse, blackish, translucent streaks on the back of each segment, and the blackish dorsal vessel visible through the skin.

It continues to feed till quite late in the autumn of its second year, when it becomes full-fed, having, meanwhile, committed very extensive ravages on the fern. The rhizome, tough as it is, though juicy at the same time, is excavated and channelled out for about the length of ten inches, in some places nothing being left but the outer rind—in others the gallery of the larva being scooped out tortuously along the outside.

During its second winter the larva remains torpid at some depth, but, on the advent of spring, approaches near the surface of the earth. It is now full grown, and, according to the sex, measures from one and a quarter to one and a half inches in length, rather thick in proportion, the folds and segmental divisions being very deeply cut, and the jaws remarkably large and prominent.

In colour the head of the male is reddish-brown, with a distinctly defined plate of the same colour on the second segment, while in the female the head is of a deeper and purplish-red, the mouth (in both sexes)

blackish, and the plate on the second segment of a pale brownish-orange, at each side blending gradually into the ground colour of the body, which is of a whitish-cream tint. The third and fourth segments have pale brownish-orange plates on the back, viz. a large drop-shaped one in the middle, extending from the back down either side, with a shuttle-shaped one before it and a similar one behind it; a similarly coloured plate is on the tip of the anal flap.

The dorsal vessel is seen through the thoracic segments as a pulsating tortuous blackish streak. The tubercular spots on the back are orange, each on an eminence of the ground colour; those on the sides are small and dusky, and each is furnished with a highly sensitive brown hair. The spiracles are black and rather large in size.

From near the end of April to the beginning or middle of May, according to the season, the larva proceeds to spin a slight cocoon of silk, covered with light earthy particles, amongst the loose vegetable soil, in which it remains a pupa for about a month.

The pupa of the male is about three-quarters, and that of the female seven-eighths of an inch long, of a uniform reddish-brown colour, thick in proportion throughout. The tip of the abdomen is blunt and rounded, the head slightly beaked, the segments deeply cut; a very prominent sharp ridge all round the twelfth segment is furnished with short hooks curved backwards, and two rather prominent ridges with similar hooks are on the back of the other abdominal segments. These hooks are gradually larger as they approach the hinder extremity, the tip of which is encircled with a few blunt spikes.

Beneath the abdomen, occupying the precise situation of the former prolegs of the larva, are pairs of short ridges, finely hooked, playing still the part of legs in the movements of the pupa, which, when feeling its final transformation approaching, bursts through its fragile cocoon and travels upwards till its wing-cases

are thrust out clear from surrounding objects, and the imago can emerge without encumbrance. This last event takes place in the early part of June. (W.B., 8, 70; E.M.M. VII, 84.)

Hepialus sylvinus.

Plate XXX, fig. 5.

My kind friend Dr. Knaggs, most obligingly sent me two larvæ of this interesting species which he found feeding on the roots of dock, and which were full grown by the 10th of July, 1866.

Each excavated a mine or trench from the outside of the root and in a spiral direction, closing it over with gnawings spun together with silk. The cocoon was formed of the same materials, but a little more compactly, at the upper end of the mine and near the surface of the earth. A few hours before the moth appeared the anterior portion of the pupa was projected above ground; it being, like its congeners, furnished with rings of hooked bristles for that purpose. The perfect insect appeared on September 10th.

The larva, being whitish and very shining, may be compared to polished ivory; it is about an inch to an inch and a quarter in length, with the segments deeply divided, and the folds or wrinkles deeply cut. The head is orange-brown, with the mouth black. A plate of brownish-orange on the second segment, and marks of the same tint on the back of the third and fourth segments, and also on the anterior legs. The spiracles are dark brown, all the other parts being immaculate. A few scattered fine hairs visible with a lens. (W. B., 20, 9, 66; E.M.M. III, 136.)

On the 10th of August, 1878, I received from Mr. J. Batty eggs of this species laid loose. Some of them proved infertile and shrivelled, but the others hatched

on the 7th and 8th of September, and were forgotten until they were dead, excepting four or five, and these were put in a bottle with a small root of dock.

The egg of *sylvinus* is globular, having a small depression on some part of it, and is jet black in colour, having a slightly shining surface.

The newly hatched larva is of a whitish flesh colour, tinged with brownish on the thoracic segments, with brown head and plate. When four days old the head and plate behind it and the anal plate show light reddish-brown, and a dorsal dark grey-brown vessel shows through the body. Minute brown dots and hairs are seen on the skin by the aid of a lens. (W. B., Note Book III, 258.)

PHRAGMATÆCIA ARUNDINIS.

Plate XXXI, fig. 2.

A few eggs laid on cork by a pinned female were sent from Wicken Fen by Mr. J. G. Ross on July 20th. They had been laid that morning and reached me the next day. The eggs were in clusters, and half of them I sent later on to the Rev. J. Hellins.

In shape the egg is long and elliptical, rounded at either end. It is of a good size with a depression on some part of it; the surface is apparently smooth, and it is whitish or almost white with a pearly gloss. On the 10th of August there appeared at one end a tinge of light brown, which grew darker, and the entire eggs became faintly tinged with very pale pinkish-brown, and on the 11th one larva was hatched.

This larva was 3 mm. long, with brown head marked with dark brown on the crown, a broad black plate next the head with a margin of pale skin in front. The rest of the body was pale pinkish-brown, with subdorsal rows of deeper brown blotches, also a lateral row and a spiracular row, the last the smallest; the

blotches on the thoracic segments were smaller than the others, dark hairs proceeding from all. (W. B., Note Book III, 148.)

Cossus ligniperda.

Plate XXXI, fig. 3.

My first figure, taken March 17th, 1860, was from a larva found at Lumley in its last year of feeding. It was observed to protrude its head from an oak tree which was being cut down, the head appearing almost close to the saw, which was employed about a couple of inches from the ground. The carpenter took it out of the tree for me; it then measured about three and a quarter inches. This must have been in its third year.

My second figure was from a larva which I concluded to be in its second year; it measured two and a quarter inches. I found it in a piece of poplar cut near the top of a decayed tree on the 22nd of April, 1873. The tree had been so infested with this species as to have lost all its foliage, and had become a melancholy spectacle in a London garden.

A friend sent me a yard of the tree, the second yard from the top; the diameter at the largest end was about a foot. It was no heavier than cork. I sawed this piece longitudinally into two halves and so revealed to view the mines which traversed it from end to end; though somewhat tortuous in character yet the three or four laid open were all more or less in a perpendicular direction with the grain of the wood, and at two or three knots, or where branches had been, there were holes or exits seven-eighths of an inch in diameter on the external surface of what little bark remained, thus rather small at the exit but larger (an inch and a quarter) within; near the opening in one was an empty cocoon of particles of wood spun together. The mines were as large as one's thumb, others the size of a

finger, one or two a little smaller, all of them quite black, in great contrast to the pale cream colour of the touchwood in which they were excavated. Those which turned off to the external orifices were wrought at a very slight obliquity through the fibres of the wood. In no instance were the fibres or the grain of the wood cut across at right angles, and in two places the mines had intersected each other. Of course woodlice and centipedes infested these old mines, and they were all very damp from the rain having found its way into them. I also observed that the black lining of these mines was tough like cuticle and could be stripped from them entire of the thickness of stoutish brown paper.

After further subdivision of the touchwood, I at length found in the least rotten part the before-mentioned larva, though not without wounding it on the second segment; the mine it lay in was very smooth and just fitted the larva, its surface slightly coloured a pale brown and rather moist, smelling strongly of the odour peculiar to the species. For the space of half an inch behind the larva it was empty, but thence was loosely stopped with "frass," like rather coarse sawdust, but very friable. It was working in a perpendicular direction downwards. Five and a half inches behind the larva this mine communicated with a larger old black chamber, whence I was able to trace it by degrees smaller to the top of the piece of wood scarcely at all discoloured and loosely filled with "frass," not at all different in colour from the untouched portions of the wood.

In 1871 two larvæ were dug up in a potato ground, in their earthern cocoons, one of which was badly broken the other slightly damaged, just enough to show me the tenant coiled round within. I placed them in separate pots with a little additional earth over them. In the latter case the larva repaired the damage to its cocoon but the former was unable to do so, or to construct a new one, though it made fruitless

efforts at either one or the other for nearly a month, but at last quietly settled down, with its body bent round into a curve, like the other I had seen in its cocoon.

In this state it remained quite motionless until the beginning of July, when towards the end of the first week it suddenly gave forth a most penetrating odour, a portent of some change. On uncovering the pot I perceived it writhing about. This continued for four days, during the second of which I saw it was pupating, which seemed a very difficult operation and was only completed on the fourth evening.

The moth, a female, appeared on the 4th of August, slightly crippled.

The other larva, which had repaired its less damaged cocoon, gave out a similar odour from its pot at the time I first noticed it in the previous larva, though the surface of the earth was undisturbed. On the 23rd of July one end of the cocoon was found protruding a little above the surface of the earth and the pupa-case to just below the wing-covers, which were opened wide apart, sticking out perpendicularly, and perfectly free of contact with anything, the abdomen remaining within the cocoon, while the moth, a perfect male, was reposing on the cover of the pot.

The cocoon was found quite perfect save only the hole in it by which the pupa had been partly thrust forth; it was lined with silk and smooth within, of great toughness, and not easily torn open. (W. B., Note Book II, 3.)

CERURA BICUSPIS.

Plate XXXII, fig. 1.

On the 13th of September, 1867, Mr. Tester lent me an example of this larva to figure; it was feeding on birch. In size and form this larva is something between the larvæ of *C. furcula* and *C. bifida*. The rich, reddish-brown, broad dorsal mark commencing on the front of the second segment is rapidly attenuated to the hump on the third; it begins again at a narrow point towards the end of the fourth segment, and widens on each segment to the eighth, where it extends much below the spiracle, which is enclosed by it; from this it narrows on each segment to the tenth, passing along the eleventh and twelfth as a broad stripe and widening again on the thirteenth. The outline of this dorsal marking on the sides of the sixth, seventh, and eighth segments is very deeply dentated, and a broad edging of sulphur yellow margins the whole of its course; a faint double darker dorsal line is visible on the middle of the back. On the eighth segment near the margin is a faint yellowish-orange spot or two, another such spot occurs near the dorsal line on the seventh and sixth, and a blackish spot on their outer circumference on each side of the dorsal line. The sides and belly are of a brilliant yellowish velvety-green, with a few faint yellowish freckles indicating by their directions two lines along the sides; the belly and ventral prolegs are sprinkled with some minute red-brown spots ringed with yellow. On the belly of the hinder segments is a central streak of red-brown, and another on each side of it on the eleventh, and a short streak of this colour down the back of each ventral proleg, and their circlets of hooks the same colour; the spiracles green, delicately outlined with black; the head dark reddish-brown, mouth paler, antennal papillæ sulphur-yellow, the anterior legs red. (W. B., Note Book II, 145).

Stauropus fagi.

Plate XXXIII, fig. 1.

On the 25th of October, 1876, I received from the Rev. Bernard Smith a very dark, quite melanic, larva of this species; it measured in length two inches and seven-eighths when the hinder segments were not elevated (which was very seldom the case), but when closely brought together with the tail elevated it only measured from one and a quarter to one and a half inches.

The head was narrow at the crown of the lobes which were slightly divided, increasing in width to near the mouth, which was well developed and also the antennal papillæ. The second segment was much smaller and the crown of the head projected over it considerably, the third and fourth segments increasing a little in size and having the usual two transverse wrinkles, subdividing each into three portions. At the base of each of these three segments the anterior legs were inserted in stout, short socket-joints, the front pair much shorter than the others, consisting of femur, tibia and tarsus, which were jointed so as to move in an inward horizontal curve, useful in keeping steady the leaf on which the larva may be feeding, the tarsus furnished with a small hook at its tapering extremity; the second and third pair of legs very much longer, the femur slightly curved, slender, but enlarged at the insertion of the tibia. When at rest this joint was elevated much above the height of the thoracic segments, the tibia, about equal in length to the femur and bent downwards from the joint, was still more slender, but swelling out a little at the insertion of the tarsus, which was a very short joint tapering and at the tip ending in a hook; the surface was shining and rather pubescent. These legs worked laterally outwards and inwards, as well as forwards; when extended outwards of course the knee-joint was lowered, but when drawn towards

their insertion it was elevated far above the level of the back.

The fifth, sixth, seventh, eighth and ninth segments were deeply divided, having elevated conical humps one on each side of the back, very prominent on the fifth, sixth and seventh, but decreasing in prominence on the others, the eleventh segment a little flattened at the lateral margin, the twelfth had a much wider spread flattened lateral rough margin, the thirteenth, still flattened at the margin, tapered rapidly to the tip, which bore a short projection curving downwards a little, and on either side of this two slender, stiff filaments, a little diverging and curved downwards a little behind; the four pairs of ventral prolegs well developed, furnished with fine hooks at their extremities. The belly rather flat. When crawling, the hinder segments were extended in line with the rest of the body so that the anal filaments touched the ground at every step, but in repose the last three segments were elevated at a right angle with the body, and when the larva was alarmed they were turned so much upwards as to project forwards a little over the back. When this occurs suddenly, and the front segments are suddenly contracted and a little arched, and the head drawn back and mouth elevated, the antennal papillæ and all the long legs in front fully extended and playing with a tremulous motion, a very threatening aspect is given to this innocent larva.

In colour the head was dark purplish-brown, with a darker purplish-crimson streak down the front of each lobe; a pale, greyish-yellowish dorsal stripe, of about uniform width, was broadly bordered with blackish on the thoracic segments and merely edged with blackish on the others, the rest of the back being brown; the humps on the fifth, sixth, and seventh segments had each from the eminence anteriorly a black streak slanting downward on to the next segment in front as far as the spiracular region, closely followed by a streak of pale brownish-ochreous; the other humps were

traversed to their summits by a similar brownish-ochreous indication of a subdorsal stripe; the side of the humps as far as the spiracular region was a deep crimson-brown; this was bounded below by a black wavy line, beginning on the seventh segment and continuing along just above each spiracle as far as that on the tenth segment, whence it slants down the side of the ventral proleg. This black line was well-contrasted immediately beneath by a paler brownish-ochreous colour, but this was soon obscured a little below by darkish brown freckles closely aggregated. The last three segments, which were generally more or less elevated, were of a dark crimson-brown colour, showing but a faint trace of the dorsal stripe or of the subdorsal; these could, however, just be traced from the darker lines of freckles which mapped out the details. The dilated margin was pale ochreous, and spotted with a row of small, raised, black dots at the very edge. The spiracles were oval, greyish-ochreous outlined with black; the anterior legs were dark brownish-red, shining and delicately pubescent; the anal filaments dark purplish-brown, growing darker brown towards the tips; the belly was slightly paler than the back, and of similar colouring; the tips of the ventral prolegs dark crimson-brown. (W. B., Note Book III, 158.)

On the 28th June, 1877, I received from the Rev. Bernard Smith, of Marlow, two eggs of *Stauropus fagi* laid on a piece of canvas by a dark variety of the female.

The egg was of a good size, circular, flattened a little beneath, and with a slight central depression above, the surface glistening as a pearl. Viewed through a strong lens it was seen to be most minutely pitted; it was cream-coloured, with a brown central spot in the depression above. On the morning of the 30th they were of a mottled appearance, reminding me of a full-ripe greengage plum, some parts like a pinkish bloom, another part at the side like an internal blotch

of deep purple, a pale, flesh-coloured ring occupied the place of the previous brown central spot, which had faded, and near this ring on one of the eggs now appeared smaller twin spots of purple. On the 1st of July they changed to a deep purple nearly all over, a small central spot of deep purple encircled by a paler halo of flesh-colour. On the morning of July 2nd the eggs appeared clouded irregularly, and one larva hatched about 10.30 a.m., whilst I was looking at the eggs. After eating a large hole in the side of the shell it began to emerge and as soon as its front segments were extruded its anterior legs began to be extended at their full length and to play continuously with a tremulous motion, whilst segment after segment issued deliberately from the shell till the entire larva, the caudal filaments last, was clear of it. It then for a couple of minutes or more turned itself round, still playing its long legs as though to rejoice in their freedom, and presently began to breakfast on the glistening, but semi-opaque white egg-shell; the first pair of legs served as hands, whilst the second and third pairs, though comparatively quiet, fidgeted about and were never still even whilst the larva was intent on its meal, which from the vigorous motion of the head seemed to be a tough one. At this time its length was three-sixteenths of an inch, even with the posterior segments and filaments erect. In all respects, both as to form and colour, it presented a complete miniature representation of the adult larva. The head, the second, twelfth, and thirteenth segments were dark brown, all the rest of the body and legs of a lighter reddish-brown, the entire surface very glossy. After stopping at short intervals to play about its long legs vigorously, in about an hour and a half it had consumed the greater portion of the egg-shell.* The second was hatched the

* I find a loose note in Mr. Buckler's Note Book that in a letter he had had from Mr. Doubleday, June 30th, 1868, the writer had said "the young larvæ of *fagi* are more like ants than caterpillars. This larva always changes its skin before it eats anything, with the exception of the egg-shell." Mr. Buckler does not appear to have himself confirmed this latter observation.—H. T. S.

following morning. They seem to have fed on the chaffy stipule of the beech leaves.

On the 8th the first larva had moulted and the second on the 9th; the cast skins having the long anterior leg-cases spread out to their full extent. On the 15th I found that the one which was first hatched had died, it seemed not to have fed since its moult. The other was very lively having eaten two long pieces out of a beech leaf, between the side-ribs down to the mid-rib, it had also eaten a piece out of an oak leaf; the larva was very dark brown and glossy.

This larva after its second moult fed remarkably well up to the 18th, and on the 20th it had moulted on the leaf-stalk, its old skin lying behind it on the stalk, and had made a good meal after the operation; it had been laid up the day before with the second segment very tumid. After its moult its head was darker than ever. On the 25th it had grown to be rather over a quarter of an inch in length exclusive of the erect tail, the colouring very dark brown and extremely glossy.

On the 21st of July the Rev. B. Smith kindly sent me two more eggs of *fagi* of a different brood, they had already changed colour and by the morning of the 23rd one was hatched and had eaten its shell, the other had done so by the following morning. I kept them separate placing both on beech leaves; both had moulted when I looked at them at noon on the 28th; one had only just completed its moult, for as I looked at it I saw it withdrawing the filaments of the tail; it became very quiet and motionless lying along the edge of the leaf, as though the operation had been exhausting.

On the 6th of August the first larva was laid up preparing to moult, the second segment very tumid, larger than the head; at 11 p.m. it remained the same, but when I looked again at 11.50 p.m. it had moulted and was much lighter in colour than before.

On the 29th of August one had been preparing to moult for twenty-four hours or longer; the real head,

covered by the tense skin of the second segment, was enormously swollen above, the old head-skin projecting forwards in front; the first pair of legs projected horizontally forwards, the long second and third pairs of legs with the femora extended horizontally forwards and the tibiæ bent horizontally backward, thus neatly folded; while thus waiting to moult the skin was shining as though highly varnished.

This larva moulted during the night and disappointed my hopes of witnessing the operation. After parting with its old skin the larva was quite velvety-looking, not having any gloss. It became full-fed and spun up between two beech leaves on the 17th September. (W. B., Note Book III, 191.)

Observations on the last moult of the larva of Stauropus fagi.

Though the earlier moults of this curious larva have been described as occurring with comparative ease, and observed to occupy no more time than from ten to fifteen minutes, or at most half an hour, for the penultimate moult, there yet remains the *last* moult for me to offer some account of; this takes place at night and is altogether a much more protracted and exhausting operation.

Specially for this purpose the Rev. Bernard Smith, of Marlow, kindly provided me in the seasons of 1876-77 with several examples of the larva, feeding on beech, but with each of them in turn I unluckily failed to witness the last moult, from my inability to continue on the watch sufficiently late at night.

However, thanks to another generous friend, the season of 1879 brought a further opportunity with a larva of *fagi*, feeding this time on oak, very kindly presented to me by Mrs. Hutchinson, of Leominster, and this was destined to compensate for my previous mischances as eventually I was able to see the whole

of the last moult, to my great satisfaction, and to bring the larva to maturity.

It was on the 3rd of September when I happened to notice the larva had fixed itself on an oak twig midway between two leaves, in preparation for its last change of skin; whereupon I placed the twig standing erect in a short bottle having a very small neck, and then by cutting away the lower leaves from the twig secured an unobstructed view of the larva, which had probably been so fixed on the twig all the previous day as it already had a double-headed appearance from the real head being mostly within the skin of the second segment. It was grasping the twig with the four pairs of ventral prolegs, and all the front segments were stretched arching backwards over the erected broad segments of the tail, thus forming a more or less circular position.

Occasionally, though at long intervals, the fore parts of the body would be gently lifted up and down a little, sometimes varied with a kind of convulsive heave, and once after many hours' stillness the anterior legs were extended laterally to their utmost stretch, quite rigid for a couple of minutes and were then gradually refolded. Quite late at night the tail segments hung down a little but were soon erected again.

The next morning and throughout the day the first pair of ventral prolegs and the second pair partly, sometimes wholly, were withdrawn from the twig, the hold of the larva being then sustained only by the third and fourth pairs, whereby the head was brought down lower than before on one side or other of the tail. As night drew on all the anterior legs were outspread to their utmost.

In the early morning of September 5th I beheld it in the same posture as in the previous night, though about noon the head was even still lower, and with the fore part of the body turned away a little on one side from the tail, and in the course of the afternoon suddenly changed over to the opposite side; thus, with

slight variation of detail, for the remainder of the day and evening continued the wonderful exhibition of muscular power and endurance.

At 10.35 p.m. the larva seemed getting restless and continued to swing itself partly round on the twig, still in the same circular posture, and in a minute or two swung back again, and then commenced, gently at first, writhing backwards and downwards, soon with increasing energy. The anterior legs having lately been folded together now began to alternately relax outwards and contract again inwards close to the body in what soon became a regular recurring rhythmic movement in unison with the heavings of the breast, until within twenty-five minutes of the expected event, when suddenly most violent writhings and rapid twistings ensued for the space of two or three minutes, and then the slower measured movements were resumed. The skin enveloping the head became glistening and throbbed in parts with a slight inflation in accord with the general heaving action of the larva; presently a series of very violent struggles occurred with the anterior legs extended laterally. These efforts proved effectual, for then at 11.35 p.m. the expected moment came, when the skin suddenly burst all round the throat, as it seemed then to be, close to the old headpiece.

Immediately there appeared a transverse yawning rent, exposing the whitish head and tender glistening bases of the short first pair of legs, held back at the moment by their sheathing of old skin which quickly drew off from them when they fell forward in their natural position. The same measured heaving to and fro movement continuing with incessant energy as the old skin (rapidly blackening) drew back and next exposed the basal joints of the second or longest pair of legs, whose long femora were soon uncovered, yet before their tibiæ were freed the third pair of legs being a little shorter and of unequal lengths were drawn out from their sheathing and slipped forward first one (the

shorter of the two) and then the other, and next the tibiæ and tarsi of the long second pair were liberated, all playing immediately after in unison with the whole body, which now unbending sustained its hold of the twig by one ventral proleg only of the fourth or hind pair, and while the old skin glided backwards by degrees the other ventral prolegs were in turn slowly stepping out as it were of their old stockings. At this time the long front crustacean-like legs began impatiently to play about and push at the old head-piece as cleverly as arms and hands to weaken the attachment and free the mouth parts, and from them the old helmet fell away just as the second pair of ventral prolegs were uncovered.

Meanwhile the hinder segments of the body had become drawn out straight and narrowly cylindrical though tapering, the caudal filaments drawn close together, forming apparently but one projecting point, which now with the hinder portions of the body became elevated almost perpendicularly, as the fore parts with the head and anterior legs were lowered in contact with the mouth of the bottle, evidently feeling for the leaf, which, as before mentioned, had been previously cut away; the third pair of ventral prolegs were next uncovered, and then one of the fourth pair, when, as the moment approached for the only supporting leg to let go its tenacious hold of the twig, I instantly held a silk handkerchief round the neck of the bottle just as the leg was removed and the old skin drawn back from it, and then the larva lay sprawling and trembling on the mouth of the bottle as the shrivelling skin drew off from the eleventh segment, and after a few efforts to hold itself on the bottle, slipped off upon the soft surrounding material, whereon for two minutes it remained perfectly still, making the first pause from the incessant motion which had been so long continued. It now lay at full length with the hinder segments slightly turned aside, all the ventral prolegs sprawling, the anterior legs extended forwards in freedom, motion-

less, sleeping apparently for fourteen minutes, and then vibrated the front legs a little, slowly turning the head round, threw out the longest pair of arm-like legs beyond the head, one bent partly over the other like a tired-out athlete enjoying repose in perfect abandonment, for there seemed something very human in the expressively weary attitudes assumed while it again stretched itself with a slight change of position and slept for four minutes more; it then awoke and shook the tail segments, which yet remained comparatively narrow, when suddenly the exuviæ fell away, disclosing the two perfect filaments; thus at 12.50 a.m. was this moult completed, having, from the rupture of the skin to this final riddance, occupied one hour and a quarter. (W.B., 5, 5, 80; E.M.M. XVII, 18.)

Notodonta tritophus.

Plate XXXIII, fig. 3.

On the 27th of July, 1882, I received from Herr Heinrich Disqué fifteen eggs of *Notodonta tritophus*, all laid loose and sent to me in a quill.

The egg was circular, convexly rounded above and hollowed beneath where it was shining, but above smooth without gloss; its colour was a bluish-greenish-whitish with a central faintly darker spot. Unfortunately they all proved infertile.

However, from the same entomologist I received on the 6th of September two larvæ of this species feeding on poplar. On the 8th I noticed that the oldest was laid up on a footing of silken threads crossing each other in all directions waiting to moult, which it did successfully in the evening. On the 11th it was much grown and the smaller larva was laid up to moult. On the 13th the largest larva was one inch six lines long, with a small humplet on the fifth, a hump on each of the sixth, seventh, and eighth segments, and

another on the twelfth, from which the outline sloped down to the end of the anal flap. The third hump is rather smaller than the others, but the humps change their outline with the position of the body, as when crawling it is sometimes in a straight line, and then the humps are obtusely pyramidal and appear shorter than when it is feeding or at rest in its more characteristic attitude, with the back of the middle segments more or less arched, and the three hinder segments elevated free from the leaf or stem to which it is holding with some or with all of the ventral prolegs.

On the 18th of September its colour changed to a dingy, blackish, velvety brown, or purplish-brown, the head only remaining unchanged. In the evening it spun up between two poplar leaves. (W. B., Note Book IV, 150.)

PTILOPHORA PLUMIGERA.

Plate XXXIV, fig. 2.

I am glad to take this opportunity of acknowledging my obligation to the Rev. Bernard Smith, for his kindness in furnishing me from time to time with a great variety of subjects for my pencil, as well as for the repeated supply of eggs of *plumigera* in 1869 and 1870, by means of which I have been enabled to work out the transformations of this rare and local species.

The eggs are laid in November, either singly or in little groups of two or three together on the young *brown* shoots of maple (*Acer campestre*), to which they assimilate well. The shape of the egg is like a conical button, being of a blunt-topped obtuse cone, rounded off a little towards the broad base and a little depressed beneath; sometimes it is not quite regular in shape, and the top instead of being just in the middle of the upper surface is nearer one side than the other. As to its colour there is generally on the rounded apex a circular whitish spot surrounded by a broad ring of

deep russet-brown, then comes a narrow ring of pale brown or dingy flesh-colour, followed by another broad one of dark brown or russet, its lower edge darkest and crenulated, and the lower part of the cone as well as the base is of a pearly whitish tint. Sometimes the central spot and the zones are not so distinct but the whole colouring is of a paler brown and more diffused. The egg does not change colour till just before the exit of the larva when it becomes a little paler; a small hole on the upper surface or on the side is the only evidence of the larva having escaped from it. The hatching takes place generally from about the 15th to the 25th of April, though this year I found it begin on the 13th and continue to the 20th.

The newly-hatched larva is about one-eighth of an inch in length, of a very pale greenish-ochreous tint, covered with long, silky, curved whitish hairs. These little fellows feed at first on the buds of the maple, and their delicate tint matches exactly that of the enveloping sheath of the bud; by the time the buds have begun to burst the larvæ have moulted and are no longer so hairy looking, though some few hairs remain. Early in May, when the crumpled young leaves are unfolding, the larva has undergone a further change; it has now a naked and smooth shining skin, is about half an inch in length, and its colour is a yellowish pellucid green, rather deeper on the back, the spiracular region and belly whitish-green; the subdorsal pale yellow stripe is already conspicuous on each side of the back, and fine twin lines of the same colour run along the spiracular region. At this stage the larva takes up its characteristic position on the inner side of the leaf where it reposes in a sort of curved posture, with the head bent round on one side towards the fifth or sixth segment of the body on the plane of the leaf.

By about the second or third week in May, according to the character of the season, the larva attains three-quarters of an inch in length. At this time the back between the subdorsal opaque white stripes is wholly

of a bright, rather yellowish, deep green, semi-transparent yet velvety, while the sides and belly are of a tender opaque whitish-green, the twin lines as before low on the sides but now white; the tubercular warts stand one before the other in pairs on the subdorsal stripes, of which they form a part, being also white; the segmental folds pale yellow. Soon after this period a dorsal stripe becomes visible for the first time, and is at its first appearance very faint and of an obscure whitish character, as though lying deep below the surface. Varieties also now occur which have two transverse bars of white on the twelfth segment and one on the thirteenth, extending over the back from one subdorsal line to the other.

At the end of May or early in June the larva attains its full growth, which is about an inch and three-eighths to an inch and a half in length, the body plump and cylindrical, rather thicker, however, in the middle than at each end. The head, the lobes of which are rounded and full, is a little less in width than the second segment. The segmental divisions are tolerably indented, and excepting on the thoracic segments there are no subdividing wrinkles on the back, though they are numerous and distinct on the sides, the back is therefore very smooth.

In colour the head is a pale transparent yellowish-green. The dorsal stripe of opaque pale blue-green has, by degrees, become wonderfully developed, and is now so broad as to occupy nearly the whole area of the back, there being but a mere line of the previous transparent deep yellowish-green left next the subdorsal white stripes, which on the twelfth segment have a tendency upward to a point as though inclined to meet one another there, but return again to their former level and nearly meet at the end of the anal flap. The sides are of a very pale and delicate opaque whitish blue-green with two fine rather wavy-looking white lines nearly parallel along the region of the spiracles. The ventral surface, legs, and prolegs, are of a glossy

pale full green. The tubercular warts are now hardly to be observed on the level smoothness of the back. Though the colouring is nearly all opaque and approaching more or less to whiteness, yet the surface of the skin is by no means rough, but has a certain faint polish, allied to smoothness, like that of a new white kid glove.

When about to pupate the larva loses all its beautiful opaque colouring and then becomes of a uniform green and semi-transparent, otherwise like the underside of a maple leaf in tint.

The pupa is enclosed in a thin brittle earthern cocoon, of a broad, oblong oval shape, and formed in an upright position, with little silk in its texture, though the interior is very smooth. The pupa itself is of a more slender form, with the abdomen somewhat more tapering than that of most *Notodontidæ*, though both extremities are rounded, the tail being furnished with a pair of very small, fine curved spikes, with which it is attached to the summit of the cocoon. The pupa skin is delicately thin, polished, and of a purplish-brown colour whilst containing the future moth.

It should be mentioned that the larvæ will feed on sycamore as well as on maple, and also that when young and even half-grown they seem to be social, as two are often found reposing on the underside of a maple leaf, folded round side by side like a schoolboy's pot-hooks.

The perfect insect appears in October and November. (W. B., 13, 12, 70; E.M.M. VII, 210.)

Microdonta bicolora.

Plate XXXIV, fig. 5.

On the 24th June, 1882, I received sixteen eggs of this species from Herr Ernst Heyne, of 18, Hospital-Strasse, Leipzig. These eggs adhered to a piece of

paper, on which they rested, scarcely one touching another, although rather close together.

The egg was of a good size and circular shape, convex above and apparently flat beneath, the shell of a delicate straw-yellow and glistening. By the evening of the 25th the shell had become more opaque and of a duller tint approaching a pearly buff, and showing two dusky specks through the surface, some of them showed in addition a faint ochreous central dark spot, of which these dark specks formed a part; these all grew deeper in colour, and by the afternoon of the 26th the large head of the embryo was plainly visible in the centre at the top of the egg, the crown of the lobes being of a dingy red colour, and the ocelli and mandibles black. The rest of the shell, which was fuller and plumper, had a faint greyish-buff tint, and with the surface duller than before. In the morning of the 27th four were hatched.

The young larva escaped by a hole eaten through the side of the shell and was tolerably active; the shining head had the lobes dark purplish-brown, the front of the face light ochreous, the body a faint tint of green and all the legs a dingy pink. By the 1st of July their bodies had become an ochreous yellow-green and the small narrow brown plate on the middle of the second segment looked still smaller from the growth of the larva; they partly skeletonised patches by eating the cuticle from either the upper or under surface of the birch leaves on which they fed. When at all disturbed they moved the fore part of the body quickly from one side to the other.

After their first moult, between the 3rd and 4th of July, they were olivaceous yellowish-green, the head with the face reddish, the dark purplish-brown of the crown of the lobes melting gradually into the paler colour of the face; minute blackish dots marked the situation of the previous brown plate, the whole skin was as glossy as though varnished; the three hind segments were often elevated a little free from the

surface to which the larva was attached, and this same habit was observed before it laid up for the first moult. At this stage they no longer skeletonised the leaves but ate through the birch leaf from the top leaving the midrib, in some instances eating out roundish portions from near the top.

On the 8th of July most of them had moulted the second time and were then 9 mm. long, the head green, the crown of the lobes darker olive-green, the body green, showing a faintly darker green dorsal line, the subdorsal stripe faint whitish, next below it a fine yellowish line, and the spiracular line beneath; the twelfth segment slightly tumid on the back, the fine tubercular dots blackish, anterior legs black. After lying still for two or three days six of them moulted the third time on the 13th, in four days they had grown, but the larva was still slender for a *Bombyx*, the length now being 19½ mm. or three-quarters of an inch, the back was pale yellow, the dorsal line thin and very dark green, the subdorsal line of pale yellow was raised and separated from the pale back by a thin line of dark green and was bordered below by another such dark line, a thin pale yellow line followed, then a stripe of darkish green, and next the inflated spiracular stripe of bright and deeper yellow, the belly green, spiracles black, having a halo of yellow, the head light yellowish-green.

The subdorsal stripe was rather lighter and brighter than the back. At this time they ate away large portions from the leaves, though the midribs still remained uneaten.

With some of the larvæ the fourth moult began on the 18th of July, others were two or three days later; after this operation the colours were very bright, the anterior legs were still black, but had greenish joints, and the ventral prolegs bore each a black outside bar above the feet, but there was no such bar on the anal prolegs, which were shorter and were often held free from contact with any object. By the 20th of July the

length was 11 lines or 23½ mm. and 14 lines by the 22nd, when it was figured the first time, and figured again on the 24th, when it had attained its greatest length, about 18 lines. It was again figured on the 27th, as during the last three days it had grown decidedly stouter; the head was now finely reticulated on the crown with whitish or bluish-green, the back of the palest greenish-white was soft and shining, the black spiracles each in a white ring on the upper edge of the bright yellow spiracular stripe, the belly a deep green, the lines bluish-green, the wrinkles across the back of each segment, four or five in number, made the subdivisions rather less noticeable than before, but they still equalled the segmental divisions which were very lightly defined.

I found this species, a very delicate one, requiring much care and attention; one spun up in birch leaves on the 29th, when three only remained alive, two of these also spun up between birch leaves on the 31st July, and the remaining one died the next day.

On the 18th of June, 1883, I bred one specimen of the moth, a male; the other two pupæ standing over. I found the cocoon spun between the leaves made of greenish-grey silk rather thin, but of tolerably compact texture; it was of rounded oval form, with the surrounding portions of the leaves very closely united. The pupa skin, and one of the remaining pupæ, measured 7½ lines, very cylindrical, of almost uniform moderate stoutness, the thorax slightly keeled, but rounded off at the head, the tail also rounded, the wing-covers closely wrapped to the body, the two abdominal rings below them being deeply divided; the abdomen tapers but little; a fine punctate roughness was nearly all over; the colour brownish-black and rather shining. (W. B., Note Book IV, 137.)

GLUPHISIA CRENATA.

Plate XXXIV, fig. 6.

On the 10th of August, 1883, I received from Herr Heinrich Disqué about twenty eggs of *crenata* laid loose both singly and in little clusters of two and four or five together.

The egg is round in shape, convex above and concave beneath, the margin a little rounded off, in colour a most delicate pale green, the surface having a pearly lustre. They seemed to be rather less shallow and to be filling out a little by the 13th, and on the morning of the 15th nine of them were hatched.

The newly-hatched larva is of a creamy-white and without markings other than the black ocelli and the brownish mouth, and an internal spot of greyish showing very faintly through the twelfth segment. They were placed on poplar (*Populus nigra*) and soon ceased wandering and began to eat out small cells in the under cuticle of the leaf, and in four days were eating quite through the leaf, and one seemed on the fifth day (August 20th) laid up to moult. At this time the larvæ measured 4½ mm. in length, and were of an extremely pale whitish-green tint, the segments plump and deeply cut on the belly.

On the 22nd one had just moulted the first time, one of the others was still laid up waiting on a little carpet of silk spun on the bottle, the others on the leaf.

The individual just moulted had the head of a whitish ground-glass-like appearance, the back of a faint tint of yellowish-green, bounded by a subdorsal yellowish line, so extremely faint as to be discerned with difficulty, below all was of a faint whitish-greenish-tint; length 4 mm.

The next morning three more had got over their first moult and their back was now distinctly green. On the 25th they were still eating out little cells from

the cuticle of the leaves of poplar, which had then been changed from *P. nigra* to *fastigiata*.

On the 30th they had moulted the second time and measured 8 mm. in length; a black dot then became conspicuous on the crown of each lobe of the greenish-white head; the back was bright green, the subdorsal stripe pale yellow, the rest was as before.

By the 2nd of September they had grown to be 14 mm. long, with the subdorsal stripe primrose-yellow, the back very bright yellow-green, with a very faint, slightly darker dorsal line, the side as far as the trachea (which showed faintly as a rather paler fine thread) was rather bluer-green than the back, and the belly and all the legs were similar, the head rather paler with the black dot on the crown of each lobe very distinct.

At this time they ate pieces from the edge of the leaves. The skin of the larva was rather glistening, and they seemed to be tender and delicate.

By the morning of the 5th both had moulted the third time, their colouring being relatively the same as before, but stronger and brighter. On the 11th one measured $19\frac{1}{2}$ mm. and was laid up to moult, the other still feeding; whenever disturbed in the least it was continually turning the fore part of its body round first on one side and then on the other, bringing itself into the usual position of *Acronycta alni* when at rest.

The one laid up to moult moulted the fourth time on the 12th and ate up its cast skin by next morning; the second moulted the fourth time on the night of the 16th or early morning of the 17th and a few hours later ate up its cast skin except the head piece. After moulting the black dots on the crown were not visible until a few hours after the operation, the body remaining just the same in colouring as before, but with feeding and consequent growth in four days' time it became 26 mm. long and had dorsal bright rust-red marks on the third and fourth segments and also on the seventh, eighth, ninth, tenth, eleventh, and thirteenth segments; on all these last-named the mark was that

of a bar across between the primrose-yellow subdorsal stripes, but divided by a very fine dorsal line of the light green ground colour, which is of a very tender and delicate tint; the head was rather paler and whiter, semi-transparent greenish; the belly and ventral prolegs similar; the spiracles were of a faint reddish flesh colour.

In form it was cylindrical, of about equal substance throughout. By the 21st it had grown to one inch two lines, the ground colour a stronger but still a light green, the subdorsal lines bright primrose-yellow, the rust-red marks were very deep and bright, most finely divided dorsally by a hair-like line of the green ground colour; it ate large pieces out of the leaves, clinging tightly to them and the more so when in the least disturbed; hence, it would probably not be easily beaten from the tree unless the leaf should be knocked off.

On the 22nd of September the most forward showed in the intervals between the red marks (and on the intermediate segments also) a dorsal stripe of whitish-green paler than the ground of the back. During the last two moults the entire colouring had been opaque though bright, the lower part and the legs of a whitish-green tint; above the anterior legs along the thoracic segments was a thin, inflated stripe of primrose-yellow.

When looked at on the 23rd it appeared thicker on the middle segments of the body and tapering at either end, though viewed from above this was less perceptible. The larva which had last moulted died on the 23rd, a fate expected by its feeding but little after its final moult. The surviving larva now measured one inch two and a half lines; it spun up between two leaves of poplar on the 25th. The moth appeared June 19th, 1883.

The silken cocoon was then found to be of an irregular, rather ovate form, of semi-transparent drab colour, one inch long, eight lines in diameter, of a light and moderately open-worked texture, but the real strength

and protection of the cocoon lay in the leaves, which had thus become so firmly bound together in forming the desired hollow cavity.

The pupa skin was just six lines long and nearly three in breadth, in figure short and rather dumpy, the head and thorax little produced and rounded, the wing-covers moderately developed and close to the body, the antenna-cases well developed, the entire under surface a little depressed or flattened, the last three segments of the abdomen tapered a little to the very bluntly rounded off end; none of the divisions were deep; the back also seemed a little flattened; the abdominal rings were more defined on each side than they were either on the back or belly.

There was a little wrinkled roughness on the thorax and wing-covers and a punctate roughness on the rings of the abdomen, but not appreciable without a strong lens. The colour was brownish-black and shining. (W. B., Note-Book IV, 159.)

APPENDIX.

[The following pages contain notes and descriptions of larvæ prepared this year (1886), by the Rev. John Hellins, with the view of supplying some of the gaps which occur amongst the descriptions left by the late Mr. William Buckler—H. T. S.]

I wish here to record the expression of my warmest thanks for the assistance given by several of my friends, whose names are mentioned in the following pages; without this help I could have done very little indeed to fill up the gaps in the letter-press.—J. H.

Procris Statices.

Plate XVIII, fig. 1.

The dates noted by Mr. Buckler* for his figures are as follows: May 16th, 1864; pale variety, April 26th; imago bred, June 25th, 1865; three larvæ, May 15th, 1866; these last, I happen to know, came from Mr. H. Doubleday, who reared them from the egg. I have his letters now, in which he says that for thirty years the perfect insects had swarmed in a certain field near Epping, but that he had never found a larva; in 1865 his man had found one larva for him, and he also that summer obtained a quantity of eggs from captured females. He then filled the brick-pit of a hot-bed with soil, planted a number of roots of *Rumex acetosa*, and covered the soil between with moss; he placed the eggs on the sorrel plants, and soon saw marks of the young larvæ being at work,—he called it *mining* the leaves but on this point I must give my own experience further on. With the approach of winter the sorrel leaves died off, and the larvæ hid themselves; the pit was not covered with sashes, but left open to the weather. In the spring of 1866 Mr. Doubleday began to look for the larvæ to reappear; once or twice he mentioned this in his letters, but he could find no trace of them and concluded they were dead, till on May 5th—a day of sunshine after a night's frost—he was passing the pit about 11 a.m. and saw some twenty larvæ all but full-fed feeding close together, and enjoying the sun, and on further examination he found a great many more; they must have fed often and often to have made such great growth since he last saw them, but somehow they had eluded his search. He then made his man notice their habits, how they ate the lower leaves of

* Mr. Stainton has been good enough to send me a copy of Mr. Buckler's short notes attached to his figures, so I am able to furnish his dates.

the sorrel, and sent him again to the field, where there must have been at that time, as he remarks, hundreds upon hundreds of the larvæ; but this time, after three hours' painful search under every plant of sorrel in the field, he could not find even one, or any trace of one! No wonder in his next letter Mr. Doubleday wrote, "There is something very mysterious about the larvæ of *Procris statices*."

My own early experience is not worth much, but I will give it in confirmation of this view of the skill with which the larva hides itself. Early in my collecting days, before I began to keep a note-book, so that I have no date fixed, but believe it to have been in June, 1856, I saw a large number of the perfect insects flying and settling on flowers in a spot which I used to frequent for collecting. I noted that near at hand there was growing almost a carpet of a small species of *Rumex*, so more than once, at the season when I understood the larvæ should be growing big, I came to this place, and on my hands and knees searched carefully, but I never saw the slightest trace of one having fed on any of the leaves. I know I was very pleased to receive some of Mr. Doubleday's larvæ on May 9th, 1866; they spun up at the end of the month, and the perfect insects appeared on June 24th and 25th.

Twenty years later, June 21st, 1886, Mr. G. T. Porritt kindly sent me a batch of eggs. The larvæ were hatched on June 29th; for several weeks I kept them in a wide bottle, and watched them feeding on sorrel leaves. At first when they were very small they burrowed into the substance of the leaf, but I did not notice that they were ever quite hidden, and they soon made semi-transparent blotches by eating away one skin, generally, but not always, the under side, and clearing away the inner substance of the leaf, leaving the skin of the other side untouched and quite filmy; this habit of making blotches in the large leaves they retain to the date of my present writing (15, 10, 86), but they also now apparently eat quite through the whole substance of the

young leaves and their stems. They are at present on a growing plant of sorrel in a large flower-pot covered with leno, and I have no difficulty in getting a sight of some of them whenever the sun shines warm upon their dwelling. They have passed several moults, of which, however, I have not been able to keep an accurate account; they are now about 8 mm. in length. As far as I have been able to make observation, the moulting is effected in the usual way through an opening in the front of the old skin near the head. I may add that I have taken a feeding larva from off his sorrel leaf, and shut him up with a spray of rock-rose, *Helianthemum vulgare*, but he would not touch it for food.

The little batch contained four rows of eggs, five or six in a row, arranged not very regularly on their flat sides; the egg is in form oblong and flattened, being about ·85 mm. long, ·5 mm. wide, and ·25 mm. deep, with the ends rather rounded, and the upper side somewhat sunken; the shell is wrinkled longitudinally and rather shining; the colour at first is light yellow; this becomes paler, and at last the head of the larva shows at one end as a dusky spot. The larva frees itself by eating out one end, but leaves the empty shell otherwise untouched. When first hatched it is barely over 1 mm. in length, of a fat, stumpy, even figure; the trapezoidal dots can be seen both placed on a slanting raised tubercle, each dot bearing one long stiff hair; the colour a full yellow, the small head looks as if yellow beneath with a glossy black tinge over. In a week's time they are 1½ mm. long, and show an orange dorsal line, with pale back and yellow sides; in two weeks just 2 mm. long, and have got through a moult, and instead of being yellow have the back now of a semi-translucent pale brownish tint, with darker interrupted dorsal line, and outside the dorsal tubercles a warm brown stripe; the hairs have become a little longer. In another fortnight another moult is passed; at the end of seven weeks they

are about 5 mm. long; the skin now set with little points, the back pale yellow with the tubercles on it darker, the dorsal line faintly dusky, the side pale brown with the large tubercles on it pink; in fact by this time they seem to have assumed much of the mature dress. Now, at the age of three and a half months, they are from 7 to 8 mm. long, very plump, slightly fusiform in figure, the head very small and retractile; the places of the usual tubercular dots are occupied by large tubercles set with short bristles, the trapezoidals being united in a pair of transversely elongated tubercles; the skin round the tubercles is set all over with tiny branched points.

I have five examples before me showing three varieties of colouring; one has the back dirty white with the tubercles on it slightly brownish, a dull pink dorsal line of varying width, the dorsal tubercles bordered on the outside with a scalloped brown line, the large upper row of lateral tubercles rose pink, and the two lower rows of small ones more brownish pink; the second variety has the back yellow with slightly brownish tubercles, the lateral tubercles pinkish, and the lower ones brownish; and the third has the back pale yellowish, and the sides dusky, with very little tinge of pink; in all the head is shining blackish, the short bristles are dirty whitish tipped with brown, the little points on the skin are shining black, the spiracles yellowish-brown, placed just beneath the large lateral tubercles. So far I can well separate them from the larvæ of *Geryon* by their greater size, their very much brighter colouring, and by the form of the dorsal line, which is not so decidedly a double dark line with a pale centre; in structure there is no difference that I am able to detect. The frass of *statices* is, as might be expected from the food, watery, and when the larvæ are small it is excluded in a long thread-like form. (J. H., 15, 10, 86.)

Procris Geryon.

Plate XVIII, fig. 3.

Mr. Buckler figured these larvæ May 2nd, 1863, and bred the imago July 19th. In 1861, June 26th, Dr. Knaggs sent me some eggs; the larvæ were hatched on July 10th, but I suppose I did not know what to do with them, for I have no further record in my note-book. In 1886 I received a good supply of the larvæ from Mr. J. Gardner, of Hartlepool, on April 19th, and on May 18th a further supply from Mr. G. T. Porritt, but coming from the same locality, where they had been captured on rock-rose, *Helianthemum vulgare*, and Mr. J. E. Robson gave me information about their habits. Most of these larvæ spun up at the end of May and the beginning of June, but three of them did not spin till June 25th. I bred the perfect insects June 22nd, 27th, and 29th. On July 1st a male and female paired, and by July 5th several eggs had been deposited. July 12th Mr. J. E. Robson sent me a pair which he had found *in cop.*, and the female began to lay on 15th; meanwhile the larvæ from the eggs of the first female began to appear on July 15th. They were placed in a bottle with sprays of rock-rose, and at once began to feed, sometimes by gnawing the surface of a flower bud or leaf, and sometimes by burrowing into a leaf and eating out a little blotch, but I never saw more than half the body of a larva inserted into the hole of its burrow. This habit continues some time, but when about a month old they eat away patches from the underside of leaves, the upper skin remaining untouched. The big larvæ eat the whole substance of the leaf or even the tender stem of a twig. I tried a larva with sorrel, but it would not touch it. Like *statices*, *Geryon* seems to feed best in the sunshine.

Through the good help that has been given me I

am able to offer descriptions of the egg, the young larva, the full-fed larva, and the pupa. I hope I may be able to bring the young larvæ from this year's eggs through the winter for better comparison with *statices* next May.

The females deposited their eggs sometimes singly, but more often in little patches of five or six, placed generally side by side in two rows. The egg is in form and structure just like that of *statices*, but perhaps a trifle smaller; it is also yellow in colour. The newly-hatched larva is just over 1 mm. in length, very stumpy, yellow, with small black head; the trapezoidals combined in two large transverse tubercles, each tubercular dot bearing one bristle. When five weeks old my larvæ were about 3 mm. long, some more, some less. They had their tubercles by this time set with fascicles of short bristles. The smaller ones were dirty whitish on the back, with an edging of dark brown, the lateral warts brownish; in the larger ones all the brown had turned to dull purplish, and the skin round the tubercles had become set with tiny black points. Now, at three months old they are about 5 mm. long, very plump, the back quite white, with the tubercles on it very slightly brownish; the distinctly double dorsal line is dull claret; the scalloped line which borders the back is deep purplish, the large lateral warts are dull claret, bordered below with a whitish line, then comes a deeper claret line, then another whitish line, and the two lower rows of tubercles are brownish-pink. I cannot see such variation in colour as noted above for *statices;* they seem rather more active, I fancy, than the larvæ of *statices*, unrolling themselves more quickly, and walking off whilst under examination.

The larvæ sent to me on April 19th, 1886, and again those on May 18th, varied very much in size, some being full grown, and some even at the later date no more than 7 mm. long, but I find I did not note very much variation in colour. The full-grown

larva is about 12 mm. long, soft, and fat looking, nearly cylindrical, and somewhat fusiform, being stoutest at segments 9 and 10; the head very small, and retractile into the second segment, which is smaller than any other segment; the segmental divisions well defined. On segments 3—12 are eight rows of large raised tubercles, those on the back being transversely elongated; all are set with fine short bristles; the skin between is set with tiny hard dots, which when somewhat magnified are seen to be like stars with five or six points. These dots do not extend below the spiracles. In colour the head is glossy black; the second segment has a blackish plate with yellowish edge in front; the back and the tubercles on it are either dingy white or pale yellow, with a double dorsal line of purplish-brown enclosing a whitish thread. The back is bordered with a waved line of claret, below which comes a wide reddish-brown stripe bearing the row of large lateral tubercles of the same colour, but narrowly outlined with pale flesh colour. This reddish-brown stripe extends to just below the spiracles, which are of the same colour and round in outline, and finely ringed with black; next comes a stripe of pale flesh colour bearing a row of tubercles of the same colour, but outlined with brown, then a stripe of brown, then the lowest row of tubercles of paler brown; the belly dingy flesh colour, the thoracic feet with blackish rings, the ventral feet yellowish; the bristles are dirty whitish with blackish tips.

The larva spins low down among the stems of its food plant a little tough webby cocoon, but not stout or papery in texture, of somewhat fusiform shape, about 12 mm. long, and 5 mm. at its widest, in colour dirty greyish with a slight yellowish tinge; the pupa is about 9 mm. long, fusiform, the head small, the abdomen plump; the eyes and antenna-cases well developed, the wing-cases long and free at the edge, the tongue-case reaching nearly to the tail and free beyond the edge of the wing-cases, with one pair of

legs parallel, nearly as long, and also free; the tail rounded; a transverse row of small points on the front edge of the back of each of the abdominal segments; the colour is a deep shining olive on the wings and head, the abdomen is more bronzy. I noticed the frass of the larvæ seemed to hang together with a little silk spinning, but whether this is so in nature I do not know. (J. H., 15, 10, 86.)

P.S.—I have just looked up a note by Rev. E. Horton, at p. 141, vol. i, E.M.M., in which he says that on May 18th, 1864, he took *Geryon*, larva, pupa, and imago at the same time; on June 2nd he took the imago of *statices;* June 9th, *statices* laid eggs, *Geryon* laid eggs June 17th; *statices* larvæ hatched, July 4th, *Geryon* larvæ, July 20th. He tried to pair *statices* ♀ with *Geryon* ♂, but failed; he could see no difference between the eggs and young larvæ of the two species, but found that *statices* would not eat rock-rose, nor *Geryon* sorrel. He found some of the *statices* larvæ veritable miners, buried far between the upper and under skin of a leaf, some only put in the front part of their bodies, and he noticed the "thread of black excrement." *Geryon* has the same habit of burrowing. (J. H.)

Anthrocera trifolii.

Plate XIX, fig. 2.

Mr. Buckler figured the larvæ on March 6th, April 15th, and May 13th, 1865; on May 18th and June 16th, 1866; and May 24th, 1869; breeding the moths on June 19th, 27th, and 30th. Dr. Knaggs sent me eggs in the summer of 1864, the larvæ from which I brought through the winter successfully, and one of them, I believe, is represented after hibernation in fig. 2. I bred moths on July 7th and 8th, 1865. In 1865 again I had eggs, the larvæ from which hatched

on June 24th, but I think I failed with them. In 1872 I had larvæ again, which were hibernating on November 3rd, and were first seen in motion after hibernation on March 11th, 1873. In 1886 Mr. G. T. Porritt sent me some nearly full-grown larvæ on June 9th, which began to spin on June 18th, and I bred moths July 7th—14th.

From these dates we get the period of flight in June and July; the larva stage lasting from the end of June, or from some time in July, until next May or June; and the pupa stage lasting three weeks or less. The only food I find I have recorded is *Lotus corniculatus*.

The egg is oblong, and rather flattened, rather over 1 mm. in length, and about ·7 mm. in width, the upper surface sunk, the shell thin and rather glistening, wrinkled longitudinally, colour full yellow, rather pale in tint. I have no record of the newly-hatched larvæ, but in E.M.M., vol. iii, p. 18, I published some observations on the growth and hibernation. "The larvæ were hatched about the end of July, and fed and grew slowly till the beginning of winter. Those I had in 1864 were about two lines (between 4 and 5 mm.) in length when their hibernation commenced, but another brood which I had in 1865 were half as long again. Having made up their minds that winter was coming, these larvæ congregated together in two or three little companies on the side of their glass cylinder, and spinning—each for itself—a firm foothold of silken threads, put themselves side by side in position for their long fast. Up to this time they had been of a green tint, with rows of black spots, and this colouring was not affected by the variation in the size, which in the different years they attained before ceasing to feed: but for winter wear there came in a new fashion altogether; they became semi-translucent to look at, and in colour dirty white; their rows of spots changed to reddish-brown, a pair of small dots only on each segment being black, and their bristles seemed more

prominent. And seeing them in such a dress at this time, one could not help thinking that it was meant to assimilate them whilst torpid to the withered stems of their old food plants. Some time in February they began to part company" (earlier than the date recorded in 1873), "and to feed again, and not long after, having moulted, they appeared in a greenish-grey coat, with a row of pale primrose spots on each side of the dorsal rows of black X-like spots. Finally the ground colour became much more vivid, either of a bluish-green or else of a rich yellow-green; but the rows of black spots on the back retained their X-like form, and this seems to be one of the chief distinctions by which this species may be known from *filipendulæ*, these dorsal rows in the latter being formed of a broad and a narrow black spot alternately."

And I also noted that the *Anthrocera* larvæ effect a moult, not by creeping out of the old skin through a split in front, but simply by standing still, and bursting it open all down the middle of the back. This year I tried to compare larvæ of *trifolii* and *filipendulæ* very carefully when full grown, but I cannot describe the forms represented by figs. 2 *c* and 2 *d*; and, indeed, I made *filipendulæ* the subject of my full description, only noting for *trifolii* such points of distinction as I thought I could detect, and some of these points may be seen in figs. 2 *a* and 2 *b*. The form and structure are very like those of *filipendulæ*, the size rather less, the ground colour perhaps more yellow, the large upper rows of black spots are more even; when the segmental divisions are hidden these spots are like X's, as shown in 2 *a* and 2 *b*, and the spots in the lower rows are also smaller than in *filipendulæ*. But it is evident that Mr. Buckler had other varieties, and I have no doubt he could have given more peculiarities for each species.

The cocoon is slightly shorter than that of *filipendulæ*, of the same substance, most generally yellow in colour, but I have one cocoon quite white. The pupæ

I measured were about 2 mm. shorter than those of *filipendulæ*, but I could see no other difference. (J. H., 20, 10, 86.)

ANTHROCERA FILIPENDULÆ.

Plate XIX, fig. 4.

This species was figured by Mr. Buckler many times; Fig. 4 was taken some time in the spring of 1865, but I have not the exact date; the full-grown larva was figured in several years at dates varying from May 13th to June 29th, and the imago also was bred by him on various days from June 11th to August 1st; sainfoin, *Trifolium*, clover, and bird's foot trefoil are the food-plants recorded by him. I have myself in former years taken the larva much oftener than I noted its capture. Dr. Knaggs sent me larvæ on July 5th, 1861; in 1869 I found pupæ from which I bred the perfect insects August 14th—24th. In 1886 I received larvæ from Mr. G. C. Bignell on June 8th; from Mr. F. N. Pierce, of Liverpool, June 17th; from Mr. G. T. Porritt, June 18th. The first spun up on June 14th; I bred the perfect insects July 10th, 14th, 16th, and a few days later; on July 11th Mr. G. C. Bignell sent me eggs; in 1869 I had larvæ hatching on September 7th, but this was late for them. Thus we have the imago in flight in May, June, July, and August; the larvæ hatched in less than three weeks from the egg-laying, then hibernating when quite small, and feeding up in early summer, the pupa stage lasting about three weeks.

I have examined the egg under the microscope, but can only say that it is much like that of *trifolii*, perhaps a trifle shorter and stouter; my memory, assisted by figures given me by Mr. Buckler, recalls the young larva as always greener than that of *trifolii;* the full-fed larva I have tried to describe most carefully, that is to say, one variety of it like fig. 4, *a;* of the other varieties I cannot speak.

The full-grown larva is 19 mm. long when at rest, 23 mm. when walking, 7 mm. across the widest part; the figure is soft and fat, tapering from segment 9 to the tail, and more gradually forwards to the head; the head is small, retractile into the second segment; the segmental divisions well cut; on each segment is a *transverse* row of eight raised tubercles, the two trapezoidal dots on each side of the back being united in an elongated tubercle, something like a dumb-bell in shape. All the tubercles are set with short hairs, the skin outside is full of little warts and points. The general colour dull greenish; all the tubercles are so coloured, and by their interference cut up the black markings; the dorsal line is yellowish-green, but bearing a yellow spot at the hinder end of each segment; on either side of this comes what would be a velvet black stripe, but is cut up by the transverse tubercles into a row of black spots, so that on each segment there is a bigger blotch in front and a smaller one behind the tubercle. When the folds are contracted the hinder blotch on each segment coalesces with the front one on the next, so as to make one large irregular blotch; below this row comes a subdorsal line of the ground colour, bearing nine spots of deep yellow placed on the hinder edge of each of segments 3 to 11; on this line commence the upper ends of a row (reckoned lengthwise) of large oval tubercles, the lower ends of which intrude into a series of black spots, hollowing them out into a half-moon shape. On the lower edge of these black marks come the black indistinct spiracles; below again comes a row of long oval tubercles, with their longer axis running with the length of the larva, and their lower sides edged with black, and then another row of small tubercles, also set in black half-moons; the ventral prolegs have triangular tubercles on their sides; the belly is green, the head and thoracic legs are black; the short hairs on the tubercles are mostly whitish, but some are black.

The larva spins a fusiform cocoon with blunt rounded

ends, and attached to a grass stem or other support, thin, but of a highly glossy close tough fabric, in colour sometimes whitish, sometimes yellow; one I measured was 28 mm. long, and 9 mm. at the widest; the pupa I measured was 16 mm. long, cylindrical, of even bulk, except that the headpiece slopes rapidly from the back and stands out distinctly, and the last three segments of the abdomen taper. The antenna-cases are strongly formed and developed, free at their tips, as is also the tongue-case for some distance, and the edges of the wing-cases; the tail ends in a somewhat rounded boss, without a spike, but bearing some short sharp points; on the front of each abdominal segment on the back is a ridge of small sharp points, reaching across to the spiracles and pointing backwards; the colour is glossy black on the head, thorax, wing-cases, and tail; the abdomen is more dingy black, with the segmental folds showing dingy greenish.

After the exit of the imago, the empty pupa-skin remains sticking in the ruptured end of the cocoon. (J. H., 20, 10, 86.)

Smerinthus ocellatus.

Plate XX, fig. 1.

Mr. Buckler has but one date for this larva, September 6th, 1876, the moth appearing July 15th, 1877; the food-plant was dwarf willow on Instow sandhills. My first record is that Mr. Buckler sent me some eggs June 11th, 1858 (just at the commencement of our correspondence); the larvæ hatched June 13th and 14th; in this year also I captured a larva on sallow July 10th. In 1868 I had a larva from willow August 4th. In 1875 Mr. G. F. Mathew gave me two larvæ September 13th, one of which went to earth on 17th. I have bred the moth on May 21st and on June 24th, and I had it brought to me from the street lamps May 30th.

In 1886 Mr. W. H. B. Fletcher sent me eggs June 19th; the larvæ hatched June 25th—29th; the earlier ones moulted about June 30th, July 7th, 14th, 20th, but did not complete their growth, sickening and dying early in August. On August 10th Mr. G. F. Mathew sent me two full-grown larvæ from Harwich. September 6th, Mr. H. Morgan, of Exeter, gave me a very large larva from his apple-tree.

Thus we have the moth in May, June, and July; the larva stage lasting some six weeks in June, July, August, or September, and the pupa stage extending through autumn, winter, and spring.

Mr. Fletcher carefully dated the eggs he sent according to the days on which the parent moth had deposited them, so I was able to trace the diminution of size between the earlier and later ones. The egg is of a plump oval form, not so deep as wide, the upper surface somewhat sunken in the middle, the shell shining, covered with a very slight reticulation, the colour a light tender yellow-green. The eggs of the first and second days' laying were from 1·8 mm to 1·9 mm. long, and about 1·4 mm. wide; those of the fifth day were 1·6 mm. long and 1·2 mm. wide; and those of the sixth day 1·45 mm. long and 1·15 mm. wide; but these last shrivelled up, and did not produce any larvæ. Three or four days before hatching the young larva can be seen curled up, and its colour is not so green as the rest of the egg outside it, and before long its red horn becomes conspicuous.

The young larva from the early laying of eggs is all but 5 mm. long, with a straight horn 1·4 mm. long. The larva from the later egg is just 4 mm., and its horn 1·25 mm.; the whole skin is covered with very fine two-pronged hairs, the usual dots emitting similar ones of stouter make; the horn is covered with tiny two-pronged spines, and has two sharp strong spines at the tip; the general colour is pale, somewhat yellowish-green, the back rather fuller in tint, the horn dull pink; the ventral feet increase gradually in size from

segment 7 to 10. After a day's growth there can be seen faint traces of pale slanting streaks on the side. At the first moult the larva is about 9 mm. long; the horn does not grow except at the moults; there is now a fuller green thread down the back, on segments 2—4 a strong yellowish-white subdorsal line, which goes on faintly to the horn, and on segments 5—12 seven whitish streaks slanting upwards and backwards. After the first moult there comes a change in the form of the head; it was rounded, but now the lobes become almost triangular, and are quite pointed at the top; the skin becomes covered with little points still emitting the two-pronged hairs; the horn is now 2·5 mm. long, and still bears tiny spines as before. At the second moult the larva is about 15 mm. long; the skin shows eight wrinkles to each segment, the subdivisions bearing each a transverse row of pale yellow points. The slanting streaks are yellow; the lobes of the head outlined on their outer edges with yellow, their sharp tips rich red; the horn, 3 mm. long, is pale yellow, with a pink line on its upper side. I should notice that the habit of the larva, whilst small, is to eat away both sides of a leaf of sallow or willow, leaving the midrib untouched, and using it as a resting-place. The larva is about 20 mm. long at the third moult, and has now become stout in figure; the face is still long, and the points of the lobes project so much that in some cases they cross one another; the horn is stout, whitish on the sides, with a purplish stripe on the upper surface; the rough points on the skin are whitish, and the lateral stripes are whitish, edged in front with deeper green than the ground. At the fourth moult the length is about 35 mm., and the tips of the lobes of the head become shortened, and lose the red tint. The biggest larva I had this summer when full grown was quite three inches (75 mm.) in length, the figure stout and stiff, stoutest about segment 10, and tapering forwards, and not so much backwards, the face triangular,

the horn on segment 12 when perfect curved at the tip, which is very sharp; each segment has eight subdivisions set with rough points; on the back there is an arrangement of these points marking out a dorsal space, but there is no line; the ground colour pale glaucous green, the rough points opaque white; on segments 2—4 a white subdorsal line, on side of segments 5—12 seven oblique white stripes sloping upwards; each stripe has its lower half on one segment and its upper half on the segment behind it, reaching almost to the plain dorsal space; each white stripe is edged in front with deeper green than the ground. The last of the seven is longer than the rest, and begins below the spiracle on segment 10, runs through 11 up to the subdorsal level, and then through 12 up into the horn; the horn is light blue, greener near the tip, and is set with white points; the spiracles yellowish-white, strongly ringed with pinkish-brown; the belly fuller green than the back, and with smaller white points; the back of the head blue, the face granulated, full green with a few white points, the lobes outlined with yellow, the mouth reddish-brown, the thoracic legs pinkish-brown, with white points on them; the ventral and anal prolegs green, with their feet slightly tinged with pink.

The larvæ went underground for pupation, making a cavity for themselves two inches down in the loose soil, but I could find little or no silk spinning. The pupa I have measured is all but 40 mm. long, and nearly 15 mm. at its widest, in figure very stout and cylindrical, the head piece rounded, scarcely projecting, the wing-, leg-, and antenna-cases very faintly developed and all soldered together, the abdomen swelling in a regular long curve, the last two segments tapering rapidly in a round curve to the blunt end, which has at its dorsal side a short, stout, conical spike set with rough projecting points, and ending in a small, strong, two-pointed spine; the skin granulated, smoother in the three wide abdominal segmental divisions; the general

colour black-brown, the segmental divisions with a tinge of claret-red. (J. H., 25, 10, 86.)

SMERINTHUS POPULI.

Plate XX, fig. 2 (see *ante* p. 20).

Mr. Buckler figured this larva on September 18th, 1860, September 12th, 1861, August 3rd and 5th, 1867; he bred the imago June 23rd, 1868. I have in my note-books a vast number of notices of this species in all its stages, from which I purpose to supplement Mr. Buckler's account of the larva by descriptions of the egg and pupa, and a list of dates. I have bred the moth on nearly every day between May 5th and June 22nd; on June 7th it was brought to me from street lamps; in 1876 I bred a moth on August 16th from a larva sent to me by Mr. G. F. Mathew on July 12th, an example of an occasional second flight; but the ordinary single flight must extend well through July because I have found eggs as late as July 27th, the larvæ from which hatched on 31st; and whilst the earliest hatching I recorded was on June 19th, the latest was on August 12th, and the egg state does not last very long; eggs laid June 21st produced larvæ July 1st. In 1882 I measured eggs from the first and the last batches of the same laying, and again in 1886 Mr. W. H. B. Fletcher's careful kindness enabled me to repeat this examination. I should like to follow the matter up by rearing a whole brood of larvæ, and breeding the moths, but must now leave this to be done by some one else; I know so much as this, that once I bred the moths from seven or eight eggs of the latest batch of a laying, and that they were all females.

The eggs I have found at large were deposited *in pairs* on poplar leaves, on the upper or under side indifferently; I suppose the fact that they were generally from five to seven feet above the ground need not in-

dicate the height at which the moth oviposits, but more probably the height at which it was convenient for me to gather leaves.

The egg is of broad oval outline, nearly as deep as wide, the shell glossy, but when magnified is seen to be covered with very fine reticulation, irregularly varying from hexagonal to almost square meshes, in colour pale yellowish-green. Some eggs I have measured were over 2 mm. long and 1·75 mm. wide, but the largest of both the layings mentioned above, those in each case laid on the first day, were 1·95 mm. long and 1·6 mm. wide; those of the second, third, fourth, and fifth days 1·8 mm. long and 1·6 mm. wide; those of the sixth and eighth days slightly smaller; those of the ninth and tenth days 1·65 mm. long and 1·45 mm. wide, and the last egg I found of the 1882 laying was only 1·6 mm. by 1·4 mm. The empty shell is generally eaten in great part by the young larva, though sometimes no more than the hole for exit; every kind of poplar seems acceptable in the way of food.

My home-bred larvæ burrowed for pupation an inch or two into loose soil, but when digging I have found the pupa barely hidden; there seems to be scarcely any silk spinning used. The pupa is extremely stout in figure, cylindrical; my measurements of its length vary from 34 to 38 mm.; the head piece slopes forward very slightly, the wing-cases short, antenna- and leg-cases not much developed, the abdomen going off in a long curve to the tail, which ends in a rough scutcheon with two knobs, and on the dorsal side a comparatively small and somewhat flattened rough spike, set with a short, stout, blunt spine; the pupa skin roughly granulated, the colour smoky-ochreous brown, with black-brown clouding. (J. H., 27, 10, 86.)

SMERINTHUS TILIÆ.

Plate XX, fig. 3.

Two of Mr. Buckler's figures have dates, July 20th, 1858, and July 25th, 1867. In my pupa-digging days I found large numbers of this species at elm trees near Exeter, and the moths when bred would pair without difficulty, and the females began to oviposit immediately afterwards. The middle of May seemed the favourite time for emerging, my recorded dates lying between May 5th and June 5th. I have, however, one curious record; on September 22nd, 1858, I found a *larva* then unchanged, which resulted in a moth August 8th, 1859; all the *pupæ* I found in 1858 had disclosed the moths in May, 1859. I had some larvæ from a lime tree nearly full-fed, which were captured in the first week of September, 1875. I noted that larvæ were hatched on June 5th from eggs laid not quite three weeks previously.

On July 7th, 1886, Mr. G. T. Porritt sent me some young larvæ which had been hatched on July 1st; they moulted four times, July 8th, 15th, 21st, and 29th, and fed on till the middle of August, when they sickened and died; I gave them lime leaves. I used to have similar results in my earlier attempts at rearing this species, and I remember Mr. H. Doubleday telling me of a brood of two hundred larvæ which throve till near full growth and then died off.

The egg is oval in form, plump, with shining pale green shell, about 1·75 mm. in length and 1·4 mm. in width. The young larva before its first moult has the head rounded, the subdivisions of the segments already marked, the skin covered with small two-pronged hairs, not so conspicuous as those of *ocellatus* and *populi*, the horn (2 mm. in length) black, thickly set with short two-pointed bristles, its end with two points; the colour yellowish-green, more full green on the back;

the figure is slender. The first moult takes place when the larva is about 11 mm. long; the horn becomes 3 mm. long, yellowish in colour with dark short spines; the lobes of the head become pointed, with yellow tips, the eight subdivisions of each segment set with rough points; the colour yellowish-green, and the seven yellow lateral slanting stripes appear plainly. The second moult comes when the larva is about 18 mm. long; the tips of the lobes of the head become reddish, the rough points on the skin yellowish. The third moult finds the larva about 25 mm. long, and the yellow scutcheon on the thirteenth segment appears. The fourth moult is passed when the larva is about 35 mm. long; up to this time the figure has been very much more slender than that of *ocellatus* or *populi*, but now it begins to grow stouter. The biggest larva I had this summer grew to be something less than 50 mm. in length, stout, but tapering forwards a good deal, the skin smooth, the dots remain but are not rough; the face triangular, the horn short and rough, a rough oblong patch on the anal flap; the back light yellow-green, the belly duller green, the dots above the spiracles yellow, below them whitish; the face glaucous green slightly dotted with white, the lobes broadly bordered with opaque white outside, tips of the lobes slightly reddish; the seven slanting lateral stripes are pale yellow, edged in front with bright green, six of them begin just at the level of the spiracles, but the seventh is longer and goes through segments 11 and 12 running up to the horn. As the larva matures there comes a red tinge in these stripes; the horn is blue above and red with yellow dots below; the rough spot on the anal flap is red edged with deep yellow; the spiracles are yellowish-white broadly ringed with red; the thoracic legs pale yellowish ringed with delicate pink, the ventral and anal prolegs coloured like the belly.

The larva generally goes underground for pupation, but I have found the pupa hidden in rough chinks of

the elm bark, sometimes as high up as six feet from the ground. The pupa is stoutish, about 35 mm. long, cylindrical, tapering somewhat to the head; the abdomen tapers a little, but ends abruptly with a triangular flattened rough spike on the dorsal side tipped with a small strong spine ending in two little hooks; the skin is finely granulated; the colour a warm dark brown with a tinge of red. (J. H., 28, 10, 86.)

Acherontia Atropos.

Plate XXI, fig. 1.

Mr. Buckler figured the dark variety of this larva August 9th, 1858, and noted the food-plant on which it had been found, *Solanum dulcamara*. In 1858 I had larvæ brought to me August 3rd, 4th, and 5th, from potato fields; they went to earth in a day or two; a moth emerged November 6th. In 1864 I had a moth given me on October 4th, which had been lately captured and starved to death, the only method which seems to commend itself to the non-entomological mind in dealing with this great creature. In 1865 I had a moth on September 22nd, and I found one moribund on some stones September 15th, 1876. Albin figured the larva, and says, "It was taken about the middle of July on the *jessamine* full-fed," and the moth "came forth at the latter end of October. There being but one of these caterpillars it could not be determined whether that is the usual season, most others of the *horn-tail* kind lying in the ground all winter till May." The "usual season" for the imago is July, but a certain proportion of the moths come out in September and October, after a very short sojourn in the pupa stage.

I never saw the egg or young larva, and can say no more of the full-grown larva than may be gathered from the figures; the shape of the horn is noticeable.

For pupation the larva goes down eight or ten inches into the earth and there makes an oval chamber very much larger than the enclosed pupa. I have two pupæ, one is 60 mm. and the other 70 mm. in length; the figure is somewhat elongated, fairly cylindrical, the head and eyes rather projecting, the outline of the back sloping up gently to the thorax, and then going nearly on a level, except the segmental folds, to the third segment from the tail, whence there is a rapid slope; on the under side the thorax is somewhat hollowed out and the wing-cases swell out a little. The segments of the abdomen are well marked; the tail ends in a large, thick, flattish rough spike, with two *very short* stout spines; the skin is glossy, but somewhat shagreened on the back at the segmental divisions, and there are two very rough pear-shaped spots between the thorax and abdomen; the colour rich mahogany brown, clouded in places with darker brown.

These notes are very scanty. *Atropos*, however, is the subject of a large amount of published observations by a great many entomologists. (J. H., 29, 10, 86.)

Sphinx convolvuli.

Plate XXI, fig. 2; Plate XXII, fig. 1 (see *ante*, p. 22).

One or two points mentioned in some notes on this species, which were published in 'Ent. Month. Mag.,' vol. v, p. 160, are, I think, of sufficient interest to be reproduced here, especially as they have some bearing on its occurrence in England. Those notes were founded chiefly on the observations of my friend Mr. H. Dorville, of Alphington, near Exeter. In 1868, between August 15th and September 28th, he captured twenty-seven males and twenty-nine females of the moth; about the middle of August he cut open a battered female, and found in her 220 well-formed eggs. On August 21st he opened another, and found

its ova undeveloped, mere small green gelatinous spots. On September 8th he shut up a damaged female in a large box, and fed her with diluted honey and sugar; on the fourth day she was dead, but she had previously laid eight eggs, and when she was opened there was not a single egg found remaining. On September 10th, a female was shut up in the same way, and she died on the fourth day without laying, and on being opened was found to have a number of eggs with shells, but not matured for extrusion. On September 16th, a female was shut up five days without laying, and then—at the point of expiring—was pinned to a cork, when she laid three eggs, and her body being opened was found to contain 160 fully developed eggs. On September 24th, a female was shut up, which died on the third day, and when she was opened no eggs were found in her.

Out of the eight eggs laid in the box six shrivelled up, the other two produced larvæ in rather less than three weeks after they were laid; these larvæ fed on *Convolvulus arvensis*, one for four days, and the other for ten days, and died without moulting. Previously, in 1859, Mr. Dorville obtained one egg from a captured female, the larva from which hatched on September 27th, but after feeding ten days on *Convolvulus arvensis*, died in its first moult.

Also on October 13th, 1859, Mr. Dorville found a larva about one-third grown on *Convolvulus* plants in a potato field.

I have no measurements of the egg, but I noted that it is not more than two-fifths of the size of the egg of *S. ligustri*, being decidedly small for so large a moth, and pale green in colour. The young larvæ were at first white, with a long black horn. (J. H., 3, 11, 86.)

Sphinx ligustri.

Pl. XXII, fig. 2.

Mr. Buckler figured this larva on August 7th, 1861, and noted the food-plant ash; the variety he figured was found in the grounds of Colchester Workhouse by Mr. H. Laver, September 6th, 1882.

I have of course a great many records of this species in all its stages; I have bred the moth often on various dates ranging from May 30th to July 14th. I have occasionally captured the moth, July 5th and 20th; eggs laid on July 5th were hatched on July 14th, nine days after; larvæ I have captured, one about an inch long, on August 7th, another full-fed on August 17th; others on September 7th and 14th; some went to earth September 10th and 20th.

In 1886 Mr. G. T. Porritt sent me eggs on July 15th; the larvæ hatched July 21st, moulted four times—July 28th, August 3rd, 9th, 15th, and went to earth August 25th to 27th; I fed them on privet, and have often taken the larva on this food, also on laurustinus and *Phillyrea;* Albin gives lilac and holly also.

The egg of *ligustri* is broadish oval in outline, plump, about 1·75 mm. long, and varying in width, some 1·45 mm. wide, others 1·25 mm., the shell rather glossy, smooth, in colour a palish tint of full green. Before hatching the dark horn of the larva shows through the shell. The young larva is 4·5 mm. long, with a limp horn 2 mm. long; the skin is thin and smooth, just a little wrinkled, the places of the usual tubercular dots marked by little bristles; the horn, which grows darker after the larva has left the egg some time, is set all over with extremely short hairs, and ends in two little points each bearing a bristle; the larva at once attacks the edge of the leaf of the food-plant; before the first moult the eight subdivi-

sions of each segment can be seen distinctly. The larva is over 10 mm. long at the first moult; when this moult is passed the skin is covered with little points arranged in transverse rows on the subdivisions of the segments, and bearing tiny bristles; the slanting streaks on the side now become visible, that is to say, on each subdivision there is one pale point in the line of the streak, the streaks thus being lines of pale greenish-yellow dots; the horn rough and black. The second moult comes when the larva is about 16 mm. long; the slanting stripes become yellow, with just a tinge of purple at the middle of the front edge of each; the horn rough, and purplish-red in colour. The third moult is passed when the larva is about 24 mm. long; the skin now feels smooth, though the dots which represent the points are still seen on the subdivisions of the segments; the face is now broadly outlined with black (though some do not assume this black border till the last moult), the purple edging of the slanting stripes is strongly marked, the horn set with points, but shining, in colour brownish-black. The fourth moult comes when the larva is about 45 mm. long; I should say the cast skin is always eaten. The full-grown larva is over three inches, = 75 mm. in length, not so stout as many Hawkmoth caterpillars, cylindrical, even in bulk for much of its length, but tapering forwards from the fifth segment to the head, which is the smallest segment, and is notched at top, with the face flat, the lobes widening below; the horn on segment 12 hard and glossy, curved downward and sharp pointed; the skin on the front segments somewhat puffed, as if to allow for the curved position of these segments when the larva is in repose; the skin smooth, but marked on each segment with eight nearly equal folds; the general colour bright apple green; segments 2 to 4 are of a fuller tint, and the belly a deeper tint again; on each of segments 5 to 11 a slanting stripe, white behind and purple in front, starting from the front of the segment a little

way below the level of the spiracle and going up to the back of the segment just above the subdorsal level, and thence still continued as a faint yellow streak, while the lower end is continued as a line of white dots on the previous segment; the stripe on 11 is continued, thinner in width, but still white and purple to the base of the horn, which is black; the anal flap is outlined with white; the face is green, broadly bordered with black; the spiracles deep yellow, the thoracic legs black with one white ring, the ventral prolegs green, with a more smoky hue downwards; near the foot a pale band, the foot itself blackish. The only variation I have ever seen has been in the size and depth of colour of the slanting lateral stripes, and I know Mr. Buckler was extremely astonished and delighted when he had the beautiful variety from Colchester given to him.

The larva goes down some distance into loose soil for pupation, having first lost its beautiful green colour and become a sad brown; the newly-turned pupa, however, is rich green. The pupa is from 45 to 50 mm. long, well proportioned, cylindrical, the head piece slopes forward a little, the cylindrical tongue-case projects free, but curves back to the thorax, about 7 or 8 mm. long, and gently swelling fuller to its tip; the abdomen gradually tapering to the tail, which has a stout, short, somewhat flattened, rough spike, set at its shoulders and tip with two pairs of short spines; the skin granulated but slightly glossy, wing-cases and folds smoother, colour a deep rich mahogany brown. (J. H., 4, 11, 86.)

Sphinx pinastri.

Plate XXII, fig. 3 (see *ante*, p. 27).

The larvæ of this species figured and described by Mr. Buckler were pupæ at the time of his death, and soon after came into my possession. I found these

pupæ in a flower-pot, some little distance below the surface of the earth; and kept them under moss in the usual way. I bred moths June 24th—30th, 1884, and one, which remained two winters in the pupa state, June 29th, 1885.

The pupa I measured was just over 40 mm. in length, cylindrical, with the tongue-case just like that of *S. ligustri*, but only 5 mm. long; abdomen tapering to the tail; the rough anal spike longer and more slender than in *ligustri*, with two pairs of short spines on its sides, and a pair at the tip; the pupa skin granulated, in colour dark red-brown. (J. H., 4, 11, 86.)

Chœrocampa celerio.

Plate XXV, fig. 2.

The larva figured by Mr. Buckler, November 8th, 1865, came from a friend at Newmarket, and fed on vine leaves. In the same year, October 19th, I had a specimen of the moth brought to me in perfect condition, except a little damage on one wing inflicted in the capture; it had been found at rest on a window-sill. Several notices of the finding of the imago and the larva agree closely with the dates I have given as to the time of year in which they occurred. (J. H., 11, 11, 86.)

Chœrocampa Elpenor.

Plate XXV, fig. 3.

Mr. Buckler figured this larva August 13th, 1858, September 9th, 1864, and August 4th, 1868; the food-plants were *Galium palustre* and *Epilobium hirsutum;* he bred the moth June 7th, 1859, and July 6th, 1869. In former years I have bred the moth on various dates from May 7th to June 21st; I have had the nearly full-fed larva brought to me from July 31st

to August 22nd; these were generally found in gardens feeding on fuchsia leaves. I never captured the larva myself, and never saw eggs or young larvæ.

In 1886, August 9th, Mr. G. T. Porritt sent me three larvæ; they were nearly full-fed, and began to spin about August 13th; they ate fuchsia and vine leaves, and flowers of *Galium mollugo*, but of course Mr. Buckler's notes give the food-plants of the species when at large; these plants grow by the water, and Albin notices "something in this caterpillar very remarkable, viz. his dexterity in swimming; for commonly feeding in or near the water, if at any time he happens to fall in, he turns himself on his back, and swims with his head and tail turned together till he gets hold on some part of the plant, by which he helps himself up again." One hardly sees how this proceeding can be called swimming; it is more like floating, unless there is any movement to and fro of the head and tail. I noticed that the frass was excluded in some seven or eight very large pellets during the twenty-four hours. The full-grown larva is nearly 3 inches, or about 70 mm. long, stout from segments 5—12, stoutest about 5 and 6, the front segments taper rapidly to the head, which is small and round; the head and segments 2 and 3 can be retracted into 4, which is then puffed; there is a small, curved, roughish horn, 2 mm. long, on segment 12; the skin generally smooth and plump. In colour there are two main varieties; one has the ground a sort of mouse-brown, buff at the folds, covered with a network of blackish freckles except on segments 2—4; these front segments have a subdorsal line of dusky buff, enclosed in a blackish border which on the fourth segment swells out into a blacker blotch; 5 and 6 have each at the subdorsal level a large blackish blotch enclosing in its upper half a lilac kidney-shaped spot, the centre of which is olive in colour, and at the commencement of each segment at the subdorsal level, the black freckles are more distinct and deep in tint; the head and horn

dull black, and there is on segment 12 a black V, with its tip at the horn; the spiracles dusky buff ringed with black; the belly buffish, freckled with a smaller pattern than that on the back, the legs dusky. The other variety has the ground colour dull green, paler at the folds, with traces of black-brown network of freckles, most distinct as a subdorsal patch on the front of each segment; there is also a dorsal line of freckles; the subdorsal line on 2—4, and the blotches on 5 and 6, as in the other variety; the spiracles pale brownish with dark rings, the belly dusky green; the horn and the V mark on 12 black.*

For pupation the larva spins a very open and irregular, but strong network of dirty-whitish silk on the surface of the soil, sticking in dry leaves and bits of earth, &c. The pupa is over 40 mm. in length, tapering to the head, which is rounded but has a keel-like projection below for the tongue-case; the figure is stoutest just at the end of the wing-cases; the abdomen cylindrical and tapering; it ends in a triangular curved spike sharp at the tip, (which I might compare to the upper mandible of a bird's beak). The three segments next the wing-cases have a ring of sharp points nearly complete, except just in the centre line of the belly; the wing-cases and segmental folds are smooth, the rest of the skin rather granulated; the ground colour light buff-brown, much clouded and smoked with blackish on the thorax and wing-cases, along the sides, and across the abdominal segments; the spike, which is rough at the broad base and smooth at the tip, is black. I fancy the figure of the pupa, 3 *c*, somewhat exaggerates the segmental divisions of the abdomen. (J. H., 5, 11, 86.)

* The general aspect of this larva, with its puffed front segments, and the curious blotches on segments 5 and 6, makes it a thing of horror to the non-entomological finder. Mr. Bignell tells me of a whole brood, which were discovered feeding on a vine in a back garden, and bravely captured with the kitchen fire tongs, and put to death as venomous beasts.

Chœrocampa porcellus.

Plate XXVI, fig. 1.

Mr. Buckler figured a larva July 29th, 1861, food *Galium verum* and *mollugo;* a green larva on *Galium verum* and *palustre* August 2nd, 1866; and one on *Galium verum* August 26th, 1869. I bred the moth, June 16th, 1867, and on July 1st—7th, 1886, from pupæ sent to me by Mr. W. H. Harwood. On July 20th, 1886, I received from Mr. G. T. Porritt some young larvæ, which had been hatched on the journey from him. These moulted four times, July 25th and 31st, and August 6th and 11th, and seemed to thrive well until they were all but full grown, and then they all sickened and died.

However, on August 6th, a full-grown larva was found by my daughter in Arundel Park, Sussex, feeding on *Galium verum*, and this soon spun up and became a pupa. The newly-hatched larvæ seemed to like the flowers of *Galium verum*, but very soon altered their taste and showed a preference for the leaves, apparently not caring to touch the flowers when a fresh supply of food was given to them.

The egg is very broad oval in form, 1·2 mm. long and 1 m. wide, the shell thin and shining, in colour I suppose light green. The young larva is a little over 3 mm. long; on segment 12 (no horn) but a raised wart set with two clubbed bristles (as if the horn had been absorbed, leaving no more than its tip), the places of the usual tubercular dots marked by tiny short knobbed black bristles; the head and segment 13 set with short black hairs; the colour pale grey-green on the back, on the front of each segment a band of deeper tint than that on the hinder part, the side greyer, the spiracular region almost whitish, the head and belly pale yellower green; in a day or two a

whitish subdorsal line with edges rather darker than the ground colour makes its appearance.

The first moult comes when the larva is 6 mm. long. After the moult the skin shows eight subdivisions in each segment set with transverse rows of whitish round dots, each bearing a tiny black bristle, the general colour pale green, the subdorsal stripe white, the head green with tiny black hairs, spiracles green, indistinct, the little wart with bristles on 12 as before. The second moult comes at the length of 10 mm., and after it was passed I noticed the larva had acquired the retractile movement of the head and front segments; the colouring much as before, the wart on 12 now pink about 0·2 mm. high, and set with a few short hairs. The third moult at the length of 20 mm. brings the first beginning of the characteristic markings; most of the larvæ remained green, but there appeared a freckling of two tints; the subdorsal stripe was glaucous green; on this stripe, in segment 5, a spot round in outline, of three colours, namely, white where the subdorsal line passes, then lilac, and then dark brown in the lower portion; in segment 6 a small white spot on the subdorsal line; the wart on 12 reddish, the subdorsal line runs up to it and ends there. At this moult one larva turned brown—freckled in two tints of brown, subdorsal line dingy buff; the spot on 5 had a reddish centre and a dark brown edge, the small dot on 6 white. The fourth moult came at the length of 30 mm., and then all my larvæ turned brown; I had not one that showed any trace of the previous green colouring. The full-fed larva was, when walking, 55 mm. long, less than 50 mm. when at rest, smooth and plump, stoutest at segments 5 and 6, thence tapering very rapidly to the head, which was very small, and with 2 and 3 retractile into 4; segment 12 tapers a little, 13 rapidly; on 12 a small two-pointed wart 0·5 mm. high; the skin showing eight not distinct folds in each segment. The colour ashy brown, freckled with black, the front of each segment being paler and bearing larger freckles

so as to look like a transverse band there; the head ashy; on 2—4 the ground is pale buff, the markings dark brown; a thin dark dorsal line; a buff subdorsal stripe outlined in black; 5 and 6 bear each on the subdorsal level a round spot, that on 5 being the larger; On 5 the spot is lilac with purple-brown centre, on 6 it is paler lilac with brown centre bearing a yellow dot; both these spots are surrounded with strong dark borders, making them very conspicuous. The wart on 12 a little paler than ground, but not conspicuous; the spiracles pale, indistinct; the belly unicolorous, pale livid hue with pinkish tinge. The larva made a very open network cocoon on the surface of the earth, working in bits of moss, &c. The pupa is rather over 30 mm. in length, cylindrical, the head-piece sloping from the shoulders, and with rather prominent eyes and a projecting keel for the tongue-case, the wing-cases short, figure stoutest about middle, tapering either way, the rough anal spike triangular, flattened, and hollowed somewhat, ending in a sharp point, the skin rather rough. On the three abdominal segments next below the wings a line of small projecting points going almost round the body; the colour dusky ochreous, much freckled with black, the wing-cases smoky (in some examples the nervures are marked out in black), a blackish dorsal line, and the abdominal segments well marked with black rings. (J. H., 5, 11, 86.)

Macroglossa stellatarum.

Plate XXVI, fig. 2.

This larva was figured by Mr. Buckler August 12th and 24th, 1867, and August 28th, 1872; the food *Galium verum* and *mollugo*. In 1859 I found a very large number of larvæ eating *Galium verum* on sand-hills during the last week of September; these spun up at the beginning of October, and I bred several

moths at the end of that month; the pupæ that did not disclose the imago before winter were found to be dead; no pupa survived the winter. In 1866 I bred the moth on September 2nd. In 1886 Mr. Porritt sent me two larvæ not half grown on September 11th. I have seen the moth often enough, but noted its ocurrence only twice, viz. its flight at 8 p.m., July 14th, 1877, and its flight about fuchsia flowers on November 19th, 1875. I know this species has been considered double-brooded, and I find a note by Rev. E. Horton, in 'Ent. Month. Mag.,' vol. ii, p. 165, saying that in 1865 he had reared a second brood from eggs found out of doors, but on the other hand most of my friends agree with me in thinking that a second brood is an exceptional circumstance. I think there is no doubt that the moth hibernates. The second volume of the 'Ent. Month. Mag.' contains notices of its being seen on the wing on December 24th and February 13th, and Mr. W. H. B. Fletcher tells me he remembers that when a boy he used to see many examples swept from an outbuilding by the gardener on autumn mornings, as though they had gone in for shelter through the coming winter; probably there is a good deal of difference, caused by the character of the season, as to the time when the hibernated moths lay their eggs, and so in some years the larvæ would be found in July, but August and September are the months in which they are usually seen.

Although bearing more on the hibernation of the imago than on the life of the larva, the following notes furnished by Mr. Stainton and Mr. G. F. Mathew are of much interest, and should, I think, be put on record.

First as to his experience in England, Mr. Mathew says he has taken the moth in May and early June, but always in a worn condition, evidently hibernated. He has sometimes taken the larva in July, but most abundantly in August, the pupa state lasting from fourteen to twenty-one days. He does not regard a second brood as impossible, but does not think it is

constant. He notices the habit of the moth in autumn to fly about the face of cliffs and walls, and twice he has seen the moth creep into holes. Then as to the south of Europe, on February 16th, 1866, Mr. Mathew saw a pair in cop. at Gibraltar flying across one of the paths on the Rock, while many others were hovering about. Mr. Stainton says that at Rome in February and March he has seen three or four moths buzzing in nearly every window of the Villa Borghese, which stands outside the walls, and both in the Campagna at Rome and in the Riviera, moths were constantly seen in flight through the early spring.

Mr. W. H. Harwood tells me he has watched the female moth laying her eggs on the flowers and flower-buds of *Galium mollugo* in his garden, and that she does not alight but keeps on the wing all the time, curling up her abdomen so as to place the egg on the underside of the flower or bud.

I am not able to describe the egg or young larva; the full-grown larva is about 45 mm. long, stout, but tapering considerably from segment 5 to the head, which is small and rounded; on segment 12 is a short, stiff, rough horn with sharp point; the skin with eight subdividing folds to each segment set with rough points; the colour either a dull grey-green or dull brown, with a darker shade of the ground colour along the middle of the back; a well-defined whitish sub-dorsal line edged above with a dark tint of the ground; a subspiracular yellowish line, the spiracles black, the points on the skin white, the horn bluish at the base, yellow at the tip. The larva makes for pupation an open cocoon on the surface of the ground, sheltered by a plant or stone. The pupa is about 35 mm. long, stoutest in the middle, tapering to the head, which is prolonged into a flattish projecting tongue-case; the abdomen tapers gradually to near the end, when it slopes off rapidly; it has a short sharp spike with two tiny straight spines at the tip; the pupa skin is thin,

slightly shagreened, but showing some gloss; the colour dull drab, with the spiracles, wing nervures, and a line on the belly from the head to the end of the wings, all dark brownish. (J. H., 18, 11, 86.)

Sesia fuciformis.

Plate XXVI, fig. 3.

Mr. Buckler's figures were taken July 17th and 23rd, 1866; the larvæ were feeding on honeysuckle; "just before changing to pupæ they became dark brown;" the moth was bred June 22nd, 1867. These larvæ came from Mr. H. Doubleday, and I had some from him at the same time; and on another occasion Mr. Doubleday sent me some moths, which he had succeeded in setting out before their wings had lost their scales.

On July 22nd, 1886, Mr. G. T. Porritt sent me four larvæ on honeysuckle, from 18 to 22 mm. long, and just at their last moult; and on August 9th Mr. W. H. B. Fletcher sent me six larvæ, so I was well supplied. I found they would eat leaves of any of the garden varieties of honeysuckle; the flowers they did not seem to touch. On August 2nd the most advanced of my larvæ began to spin, and soon afterwards became a pupa, but with most of the rest I was not successful.

Mr. W. H. Harwood informs me he has watched the female moth ovipositing; like *Macroglossa stellatarum* it remains all the while on the wing, and curls up the abdomen so as to place the egg on the underside of a leaf.

The larvæ I had this summer were set with rough points before their last moult, otherwise much as when described afterwards. The full-grown larva is about 35 mm. long, stoutest at segments 9 and 10, tapering forwards, but not rapidly; the face slightly wider at the mouth than above, the lobes set with some

small points; the skin with eight folds to each segment, bearing dots, but really smooth; the horn on segment 12 rough, curved, and sharp at the tip; the general colour a beautiful green, the back whiter green, with a dorsal line showing at the folds; the subdorsal line yellow, ending at the horn, which has the base lilac, the middle claret-brown, and the tip brown; the spiracles bright rust-red in colour, with a white dot above and below; in one specimen the spiracles were surrounded by reddish-brown pear-shaped spots; the belly red-brown, with a yellow line edging it, the anal flap edged with yellow; the head of a bluer green than the body. The larva forms a very open cocoon on the surface of the ground of dirty whitish and pinkish silk, stuck over with bits of earth, &c; the pupa is about 24 mm. long, cylindrical, stout across the wing-cases, tapering to the head, which is conically rounded; the abdomen tapers off considerably to the tail, which has a flat, triangular, sharpish spike; the pupa-skin granulated, but rather glossy, the colour rich brown, with a blackish shade on the centre of each segment, and blackish outlines to the wing- and antenna-cases. (J. H., 18, 11, 86.)

Sesia bombyliformis.

Plate XXVI, fig. 4.

Mr. Buckler figured this species on July 17th and 21st, 1866. The larvæ were feeding on *Scabiosa succisa*, and were sent to him through me by Mr. H. Doubleday. I have never seen any other larvæ, but in 1858 I took the moth at flowers of red rattle during the last week of May and the first week in June. The locality was a rough field surrounded by woods; the trees have since been cut down, and the field ploughed up, and I have had no other opportunity of studying this species. (J. H. 18, 11, 86.)

Sphecia apiformis.

Plate XXVII, fig. 1.

The only date which Mr. Buckler has for this species is February 25th, 1861, but as he also records that the larva was taken out of its cocoon, the fact of the cocoon being complete at this time of the year is established. I have never found this species at large in any stage, but have had cocoons given to me at various times.

In 1886, March 8th, Mr. W. H. B. Fletcher sent me a dozen cocoons, some of which I opened in order to describe the larvæ within; the opening was effected by cutting a slit through the whole length of one side, and when I had done with each larva I replaced it in its cocoon, the shape of which had not been altered, and by the next day I found in each case the slit had been spun together, and after another day or so it was hard to distinguish the cocoons thus operated on from those that had not been interfered with. Mr. Fletcher and Mr. F. D. Wheeler inform me that the larva bores in the bark and wood of *Populus nigra*, a few inches above the soil and also below it, and its gallery is driven not only into the trunk of the tree, but also through the main roots, sometimes running to a considerable distance from the trunk; from the varying size of the larvæ found in the same tree they conclude that the larval stage lasts for two if not three years. When the larva has ceased feeding it constructs its cocoon in its gallery near its exit, or sometimes in the soil near the tree, becomes a pupa in May or June, and the moth emerges in June and July; some of those I had this season were bred during the first week of June.

The cocoon is cylindrical, with rounded ends, from 25 to 35 mm. in length, and about 12 to 18 mm. in width, tough in texture, being formed internally of stiff silk, and coated externally with raspings of wood, but its substance is not much more than 1 mm. in thick-

ness; the outside is dark brown, the inner lining of glossy silk is purplish-brown, except at the end, where the head of the larva lies, and there the silk is dirty white, and not so stout as elsewhere.

I do not know if the larva becomes shortened soon after it spins up; those I had varied in length, the longest being 33 mm.; the figure is somewhat wider than deep, widest at segment 3, more flattened in front, and more cylindrical and smaller behind, 13 being the smallest segment; the head hard and horny, flattened, about two-thirds the width of the second segment, into which it is retractile; 2 is longer than any other segment, and has a shield wide in front and narrowing behind; the positions of the usual dots marked each by a tiny hair; the spiracles small, the thoracic legs small but well developed; the ventral prolegs scarcely developed at all, looking more like a fold of the ventral skin, and the discs of hooks are no more than two little rows of points for each foot; the thirteenth segment is curved under, and the anal prolegs are like two lobes at its end, and are furnished with scarcely discernible points for hooks; the skin is soft and glossy, yellowish-white in colour, the head rich chestnut-brown, the mouth paler, but outlined with black. The second segment is more yellow than the rest of the body; spiracles ringed with red brown, the hairs brown. Altogether this larva, though looking like a soft maggot, is well adapted for eating its way through wood.

The pupa seems to vary in size; probably the female is generally larger than the male. I measured one 22 mm. long and 8 mm. at its widest; in figure elongate, cylindrical, the back of the thorax rounded off over the back of the head, and where this curve meets the flatter outline of the underside, between the eyes and just in front of the base of the antenna-cases, is a slight projection, 1·5 mm. in length, with central keel and side ribs, apparently to be used in cutting open the end of the cocoon; the eye-covers and leg- and antenna-cases very distinct, but all soldered close to

the pupa; the tongue-case straight with the tip free; the wing-cases small but distinct, and at their lower ends free for 3 mm.; each of the first five segments of the abdomen has two transverse rows of sharp points, one at the beginning of the segment, reaching across the back and below the spiracles, the other about the middle of the segment and not so long; the next three segments have one row each, but of stouter points. The tail is rounded off underneath, with no spike but a rough scutcheon. The back of the thorax is rounded, and falls in a little at the waist. The back of the abdomen goes on in a long slight curve, the outline of the belly straighter; the skin glossy, the colour rich brown. Before the emergence of the moth the pupa works its way out of the cocoon. (J. H., 24, 11, 86.)

Sphecia bembeciformis.

Plate XXVII, fig. 2.

Mr. Buckler has two dates for this species; "taken from the pith of a sallow stem of 1½ inches diameter, May 1st, 1861, and from poplar June 5th, 1861." I give his words in full, because of the two kinds of wood being mentioned; I know nothing of this species at large from my own observation, but have understood that its food is the wood of sallow stems.

In 1886, March 27th, Mr. F. Norgate, of Downham, Suffolk, sent me some larvæ; others were sent on March 31st by Mr. A. Houghton, of Wicken, and on May 21st by Mr. G. T. Porritt; some of these larvæ had been extracted from their galleries, but most of them were sent in their galleries bored lengthwise through sallow stems, which varied in diameter from half an inch to two inches or more. Mr. Norgate informs me that he finds the larvæ all through the winter, and up to the first week of July, in their galleries in the wood of *Salix capræa* from about the

level of the ground to about a foot above it; that the larvæ become pupæ from the middle of June onwards at the upper end of their galleries; the moths emerge from the end of June to the beginning of August, but generally during the first fortnight of July. Those I bred this year appeared early in June.

I examined these larvæ carefully, but except in the point of size I could not well separate them from those of *apiformis;* they were about 25 mm. long, the longest I measured being 28 mm.

The change to the pupa takes place in the upper end of the gallery, which is smoothed and slightly lined with silk; the head of the pupa points to the exit, and the gallery is closed below it with a tough but thin spinning of white silk coated with wood raspings.

I found the pupa also very like that of *apiformis* in structure and colour; perhaps it is rather paler, and of course it is smaller in size, and I thought the transverse rows of points on the abdomen seemed sharper, perhaps on account of the pupa having to travel farther before the moth emerges. (J. H., 24, 11, 86.)

Trochilium cynipiforme.

Plate XXVII, fig. 5 (see *ante*, p. 47).

Mr. Buckler figured this species from larvæ in oak bark, March 21st, 1866, and November 6th, 1868; he bred the moths June 29th to July 2nd, 1869.

In 1886, on October 5th, Dr. T. A. Chapman sent me from Hereford some larvæ, which he had taken in bark of stumps of felled oaks; their usual habitat, he tells me, is at the open edge of the bark at the top of the stump where it was cut across, but in a stump which had been inhabited for two years or more, and which was decaying, he found larvæ entering the thick bark lower down; he considers the larval stage to continue through two years. At the date above men-

tioned one larva was 10 mm. long, and another quite 15 mm., and probably full-fed, as it was enclosed in a tough cocoon of gnawed bark in a chamber hollowed on the surface of the piece of bark which came with it; these larvæ were alike, except that the bigger one had a pink tinge. The figure is somewhat flattened, segments 2 and 3 stouter than any others, the body tapering thence to 13, the head flattened with rounded outline, set on to the upper edge of 2, the jaws like short, straight, powerful nippers, a trapezoidal plate on 2, and a small plate on 13, the skin soft, transparent, the places of the usual dots marked with tiny hairs; the thoracic legs small, the ventral prolegs so far developed as to have oval discs of hooks, anal prolegs soldered together as two lobes of the last segment; the colour dirty white, the internal organs showing through blackish, the head red-brown, with black jaws, the plate on 2 tinged with brown and with darker outline, plate on 13 slightly brown, spiracles indistinct, yellowish. (J. H., 25, 11, 86.)

Trochilium sphegiforme.

Plate XXVIII, fig. 1 (see *ante*, p. 49).

Mr. Buckler's notes are as follows, "In alder suckers, October 8th, 1866, from Burnt Wood, Staffordshire. Larva from Mr. Tester, June 17th, 1867, Balcombe, Sussex."

Trochilium scoliæforme.

Plate XXVIII, fig. 2.

The only note appended to this species is, "In old birch bark, April 10th, 1863."

Trochilium tipuliforme.

Plate XXVIII, fig. 3 (see *ante*, p. 49).

Mr. Buckler's notes are, "March 9th, 1861, in pith of currant; in stems of black and red currant, March 22nd, 1869." I have several times captured the moths, apparently just emerged, in the second and third weeks of June. (J. H., 25, 11, 86.)

Trochilium myopæforme.

Plate XXIX, fig. 1.

Mr. Buckler figured this species March 5th, 1867, from larvæ in bark of apple trees. In 1886 Mr. G. T. Porritt gave me some larvæ sent to him from Wicken, on May 21st, and again on June 26th, but most of them had been injured in being extracted from the apple-bark; however, one of the first batch had become a pupa by June 26th, and one of the second batch also came to full growth, and from it I bred the moth on August 10th.

The larva I described was 15 mm. long, of even bulk, rather flattened, the head with rounded sides, retractile; segment 2 wider than the others, the skin thin, wrinkled; the segments distinctly cut, the hinder side of each being higher than the front of the next; the usual dots inconspicuous, but slightly raised and placed on horny spots, each with a short bristle; the whole of the back of segment 2 is covered with a horny plate, the hinder curve of which spreads partly over 3; the colour dirty white, with a pinkish pulsating dorsal vessel, and an internal purplish pink tinge from 5 to 8; the head shining red-brown, the plate on 2 slightly tinged with bright brown; the ventral prolegs very little developed.

The cocoon I examined was formed in a hollow eaten out of the bark, and was lined with a tough whitish silk fabric, covered outside with gnawings of bark, in length about 11 mm.; the pupa was 9 mm. long, cylindrical, slender, tapering gradually to the tail, which was bluntly rounded off, and had no spike, but had a circle of strong points; the first five abdominal segments had each two transverse dorsal rows of points, the next two one row each; the skin very smooth and glossy; the colour very light brown, wing-cases slightly darker, the head and the rows of points darker still. After the exit of the moth the empty pupa-skin was left protruding from the cocoon. (J. H., 25, 11, 86.)

Trochilium culiciforme.

Plate XXIX, fig. 2.

There is no more noted about this larva than the food and date: "In birch, May 22nd, 1861."

Trochilium formicæforme.

Plate XXIX, fig. 3.

Food and date are recorded: "In osier stems, June 27th, 1865."

Hepialus lupulinus.

Plate XXX, fig. 2.

Mr. Buckler figured the larva, I know, in 1860, but the exact date is not noted; the pupa was figured in 1870, and the moth from it bred on May 27th. This figure was probably done hastily, at all events the pupa should have no such *hairs* as are indicated in fig. 2, *a*,

they should be merely rows of sharp points; by means of these points the pupa not only emerges from its cocoon in preparation for the exit of the moth, but also travels actively up and down its long cocoon at any time when alarmed during that stage of the insect's life. I never found the larva, but I have found the cocoon, and amused myself by putting the pupa through its paces within.

In 1886, April 22nd, Mr. G. T. Porritt sent me several larvæ, which he dug up; I supplied them with dead nettle, *Lamium purpureum*, on the roots of which some of them fed, but several had ceased feeding, and did not even attempt to conceal themselves, but became pupæ on the surface in four or five days; naturally the larva and pupa stage both would be subterranean.

The full-fed larva is about 20 mm. long, fat looking, like a maggot, with the skin white and shining; the head and collar bright brown, the usual dots pale yellowish-brown, each with a short stiff black hair, the spiracles black. (Probably the larva before it has begun to shorten for its change is more than 20 mm. in length.) The pupa is 17 or 18 mm. long, cylindrical, of even bulk throughout, the headpiece slopes to the mouth, just above which is a small wedge-shaped projection, the antenna-cases prominent but short, the wing-cases very short, the abdominal segments deeply cleft and very movable; five of these segments have each two transverse dorsal ridges armed with teeth, and four of these have also toothed ventral projections; the last of these is very prominent. The tail ends bluntly, and has two diverging warts but no spike; the pupa-skin is glossy, in colour pale reddish-brown, or brownish ochreous, darkest on the head and wings, the spiracles and the toothed ridges dark brown.

The larvæ of the various species of *Hepialus* must be much alike, but if they could be compared together in life, no doubt good points of distinction could be found. (J., H. 2, 12, 86.)

Hepialus humuli.

Plate XXX, fig. 3.

Mr. Buckler figured this larva May 1st, 1861, at roots of dock; May 10th, 1862, at roots of grass, the moth was bred June 23rd; April 25th, 1868, at roots of dandelion, the moth bred June 18th; the pupa he figured June 11th, 1867, and bred the moth June 27th. I have had the full-grown larva, but took no notes of it; it is subterranean in its habits, feeding on the roots of many plants; the pupa, like those of its congeners, is of the long "daddy-longlegs" form. Dr. Chapman has recently ('Ent. Month. Mag.,' vol. xxiii, p. 164) established the fact of the female moths seeking the males for pairing; while ovipositing they hover over the tops of the grass in meadows, "dropping their eggs loosely, and if captured continue to do so into the hand or into the box." In 1886 Mr. G. T. Porritt and Mr. J. E. Robson sent me eggs on July 15th, and Mr. J. Anderson on July 24th. From the earlier batches the larvæ began to hatch on July 29th. Being from home at that time I kept some of them in a bottle with tufts of grass for a while, but on August 19th I put them into a flower-pot with grass and dead nettle growing; since then I have seen some of them on September 13th, when I disturbed the earth to look for them, and on October 26th I saw one which had come out of the earth, and had crawled up the side of the flower-pot for an inch or two, being, as I supposed, in some way incommoded by the very damp state of the earth. From the rate of growth observed at these dates I am inclined to think that *one* year would suffice for the whole life of this species, the larva stage lasting from August till the next May, but of course I cannot speak positively.

The egg is small for the size of the moth, broadly oval, about 0·7 mm. long by 0·5 mm. wide, the shell smooth and very shining, colour at first white, but

soon turning black; this change seems somewhat strange, as the newly-hatched larva is white. The young larva is just over 2 mm. in length, slender, the head pale brown, the body white, the skin somewhat transparent, the internal organs showing dark, the places of the usual dots marked with little black hairs; it is very active, and can shuffle backwards as quickly as forwards. In three weeks' time the larva is 4 mm. long, still whitish with brown internal stripe, the head dark brown, the usual dots now visible, being black but very small. At the end of seven weeks the larva is 8 mm. long, much as before; there is now seen a black collar on second segment. At the end of thirteen weeks the larva is 17 mm. long, the head long-oval in outline, and glossy red brown in colour, set flat with the body; the body dirty whitish, with a blackish line down the back, lessening in width to segment 10, where it ends; a large shining plate on the second segment reddish-brown; the tubercular dots distinct, horny, the largest being the round front pairs of the trapezoidals, in colour brownish, each with a short stiff hair; the hinder part of the body tapers a good deal; the thoracic legs long and thin, and the ventral prolegs well developed, but the larva seems not at ease on a flat surface, being adapted for living in a gallery; the spiracles small and black. (J. H., 2, 12, 86.)

Zeuzera æsculi.

Plate XXXI, fig. 1.

Figured by Mr. Buckler May 2nd, 1861, in a stem of lilac one inch in diameter; October 27th, 1869, from a broken branch of lilac; the pupa and cocoon July 5th, 1875, from poplar. Of this species, plentiful enough about London, I know little; I have had eggs, but not described them; in 1874 I had some eggs, which I put about in crevices of the bark of some

shrubs in my garden, and next year, on June 18th, I noticed that a small bough of birch, not thicker than my forefinger, had been broken across by the wind, and on closer examination I found a larva of *æsculi* had driven a gallery along it, and had become a pupa there. I remember noticing the rows of little spikes, which seem well represented in fig. 1, *b*, and of course are of use to enable the pupa to move to the entrance of its gallery for the exit of the moth.

In 1886, July 14th, Mr. G. T. Porritt sent me a larva; it was then 25 mm. long, stout, the skin thin, the tubercular dots very large and black, and each bearing a fine bristle, the segments well divided, the head retractile and narrower than segment 2, rounded in outline, in colour shining blackish-brown, but with a pale mark on the summit, bell-shaped, with the broad end in front; the second segment larger and wider than any other, covered for its whole length with a wide dorsal smooth plate, blackish-brown in colour, shining, armed on its hinder edge with teeth, large in the middle and small on either side, the following skin-fold bearing some small points; the anal flap covered with a hard, black-brown plate set with some bristles; the general colour of the skin deep dull yellow, the pale brown spiracles deeply sunk in little pits, the tubercular dot preceding each spiracle very small, all the others large; the anal prolegs scarcely developed, just a line of hooks to mark each of them. Unfortunately this larva died, having, I suppose, been turned out of its mine, and not possessing energy enough to begin a fresh one. (J. H., 2, 12, 86.)

PHRAGMATÆCIA ARUNDINIS.

Plate XXXI, fig. 2 (see *ante* p. 58).

Mr. Buckler figured the larva May 22nd, 1863, in stems of *Arundo phragmites*. It was in 1882 that he

sent me the eggs mentioned at p. 58. I found them about 1·5 mm. long, and about 0·8 mm. wide, the shell thin and smooth, rather iridescent. I did not attempt to rear the larvæ, but attached the cluster of eggs to a plant of *Arundo* the next time I was by the waterside, and, perhaps, may have set up a new colony. Mr. H. Doubleday sent me some pupæ in June, 1860, from which I bred the moths in the second and third weeks of July. I have the pieces of reed still with his blue ink mark pointing out the orifice in each from which the moth would escape. In 1886 Mr. G. T. Porritt sent me two larvæ of very unequal size, one being almost thrice as long as the other, on May 21st; and on May 28th Mr. W. H. B. Fletcher sent me a dozen larvæ of various sizes, some apparently quite full grown, but I was not lucky enough to get any of them into the pupa, although they seemed lively and moved from one piece of reed to another. Mr. Fletcher tells me the larva must live for two years at least as an internal feeder in the lower parts of the *Arundo* stems, in fact underground; the change to the pupa seems to take place higher up, but the pupa is active and moves up and down the hollow reed stems; the larva prepares for the emergence of the moth by gnawing a thin spot in the side of the stem, and then lining it with a thin web of silk very much of the same colour; it also stops up the hollow of the reed just above with a diaphragm of whitish silk mixed with raspings of the reed; the pupa forces more than half its length out at the prepared orifice, and when the moth emerges the empty skin is left there sticking.

I described fully a larva 26 mm. long, and examined another 10 mm. long, and another 40 mm.; in figure they were all alike, and differed only in their lighter or darker colouring. Length of the one described 26 mm., figure slender, somewhat flattened, of nearly uniform bulk throughout, the thirteenth segment long and tapering; the head horny, flattened, but with rounded outline, a horny shield all across the second segment swell-

ing out with a rounded edge behind and encroaching on the third, the hinder part of this shield curiously set with dark scales which project backward, and must help in progression, thoracic legs short and small, ventral prolegs little developed, the feet being short transverse rows of little points, the anal prolegs merely a bilobed prolongation of 13; the skin somewhat wrinkled, but shining, the usual tubercular dots indistinct, each with a small bristle. Colour all over dirty creamy white, head and segments 2 and 3 pale brown, a broad, pale, purplish subdorsal stripe, spiracles pale brownish, small and indistinct, except the one on segment 2, which is very large and oval in shape; on 3 and 4 are black, round, false spiracles, the belly more whitish than the back, thirteenth segment pale, translucent and horny. The small larva, 10 mm. long, seemed to taper a little from 3 to the tail; it was yellower in tint, and the subdorsal stripes more purple; in the large larva, 40 mm. long, the stripes had almost disappeared.

The pupa I have measured is about 28 mm. long, very slender, barely 4 mm. across, cylindrical, even in bulk throughout; in the front of the headpiece is an angular projection like a tiny beak, the wing-cases short, on the back of each of the abdominal segments two transverse rows of very small points; these rows are wide apart, one at the beginning, the other at the end of the segment, the skin otherwise glossy, the tail blunt, surrounded with a coronet of strong spines, and on the dorsal side there is a very short, blunt spike set at the shoulders and tip with small points; the colour seems to be brown, paler on the wing-cases and darker on the abdomen. (J. H., 3, 12, 86.)

Cossus ligniperda.

Plate XXXI, fig. 3 (see *ante*, p. 59).

Mr. Buckler figured this larva March 17th, 1860, from oak; in 1873, on April 24th, from oak; on May 29th

from elm; and on October 9th from elm; the pupa July 22nd, 1871, the imago from which was bred August 4th.

I have never seen the egg, and have no description of the *small* larvæ I have occasionally found, but remember them as rather fuller coloured than the larger ones. In 1886, August 7th, Mr. G. T. Porritt sent me five larvæ, the biggest of which I described, but it was not full grown, and would feed, I suppose, through the autumn, before it made its cocoon for hibernation. Its length was 50 mm., greatest width 10 mm. at segments 2 and 3, figure thence tapering backwards, 13 being the smallest segment; the segments well cut, the head flat, almost heart-shaped in outline, with very hard strong jaws; the fold behind the head flexible; segment 2 flat, quite covered with a horny plate; a plate also on segment 3, and on 4 a smaller one notched on the back edge; the remaining segments with apparently three subdivisions in each, viz. a narrow one in the middle and a broad one at the beginning and end. The usual tubercular dots look horny, but wrinkled and somewhat depressed, each with its stiff bristle, the spiracles large and horny, all the legs well developed except the anal prolegs, which, though more developed than in *Sesia*, are still like two lobes of segment 13; this last segment seems somewhat horny; the colour on back full mulberry, the sides to the spiracles rosy pink, below that a more yellow pink tinge; the head shining black; the front of segment 2 pale pinkish shading into reddish-brown, on the hinder part a transverse black mark with two projecting oblongs behind; the spiracles brown, thoracic legs brown, prolegs pale pink with brown hooks; segment 13 paler than the rest. The pupæ I have measured are about 40 mm. long or somewhat over, cylindrical, the head sloping forwards, between the antennæ and eyes a projecting keel ending in a sort of knob, below which comes a short groove; wing-cases short; seven of the abdominal segments have on each two transverse dorsal rows of teeth reaching to the spiracles,

but no further, those on the first segment between the wings are small, and the second row on the seventh is very small, then come two segments each with a single row of larger teeth, and the tail ends in a rough escutcheon bilobed in the middle, and with a few blunt points; no points on the belly, but cicatrices in the places of the larval prolegs; the skin somewhat glossy, rich red-brown, paler at the segmental folds. (J. H., 3, 12, 86.)

Cerura bicuspis.

Plate XXXII, fig. 1 (see *ante*, p. 62).

I have no more to add to Mr. Buckler's notes beyond the fact that alder is also the food of this species; in 1886 I beat a half-grown larva from alder, September 9th. (J. H., 9, 12, 86.)

Cerura furcula.

Plate XXXII, fig. 2.

Mr. Buckler figured this larva in 1860, October 26th, from sallow, also the piece of willow-bark showing the cocoon; in 1867, August 23rd, from osier, and October 3rd and 4th, from sallow, these last being larvæ taken at Rannoch; he bred the moths May 17th to 19th, 1868. In 1865 I had pupæ given to me, and bred the moths June 1st to 8th. In 1886 I received larvæ from Mr. G. T. Porritt, July 9th; these were quite small, and the journey in the hot weather seemed to have injured them, for they died very soon; August 19th, I had larvæ from Mr. W. H. Harwood, which began to spin on the 21st. September 2nd, Mr. W. H. B. Fletcher sent me several larvæ varying in length from 12 mm. to nearly 30 mm.; and on September 6th I had from Mr. G. T. Porritt some larvæ on the point of spinning; I fed them all on osier and narrow-

leaved willow, the leaves of which I have noticed are sometimes distorted and discoloured by gall insects in such a way as to offer considerable resemblance to "kitten" larvæ, and the mimicry of this appearance doubtless in its degree goes to protect these larvæ from birds.

I have never seen the egg: of the larva I took notes at three stages; but before I transcribe these notes perhaps I may preface them by a word or two on the nomenclature I use for the characteristic structure and colouring of the *Cerura* larvæ. The projecting warts on either side of the head on the front of segment 2 are of course not *horns*, but in the young larvæ they look so at first sight, and so I have called them; the dorsal pattern I call the *saddle*, and its extension down the side of the eighth (and sometimes seventh and ninth) segment would thus be *flaps* or *stirrup-leathers;* the double process standing out from segment 13, whence *whip*-like filaments are protruded, I simply call *tails;* these I used to consider a modification of the anal prolegs, but now, through Dr. T. A. Chapman's good teaching, I regard them as dorsal appendages, somewhat after the fashion of the anal spines of the larvæ of the *Satyridi*, which of course exist together with the anal prolegs. Having had more opportunities of studying the larva of *C. vinula,* I give most details of that species, and make it my standard of comparison; the *Cerura* larvæ always after a moult eat up the cast skin, except the head cover, and the empty tubes of the tails. Dr. Chapman considers that they thrive better if they also consume the silk-spinning on which they fix themselves during a moult.

The youngest larvæ I described were from 3·5 mm. to 4 mm. in length, their tails 1·5 mm. long; the head brown; the back bright yellow on 3—5, dark brown on 6 and 7, pale yellow on 8, 9, and front of 10, and brown again on the rest; the sides pinkish brown. A larva 12 mm. long had its tails nearly 6 mm.; the horns on 2 quite long, the dorsal saddle fully developed

and coming down low, with a square stirrup-leather on the side of 8; the colour of the saddle rich brown, tinted with crimson; a very fine yellow dorsal line with dark edges, and some yellow slanting lines on 6—9; sides rich yellow-green, belly more glaucous green, some very small dark dots on the side, the spiracles ringed with brown, the tails pale brownish, with two yellow-green rings.

The largest larva I described was over 30 mm. in length, the tails 7 mm. long, the figure was of the pattern of *vinula*, but more slender; the head small with flat face, the front of 2 wide and squared, and bearing still two rough, low projections; on the hinder part of segment 3 a transverse, dorsal hump, the body from 10 diminishing to a point at 13, the tails slightly rough. The dorsal mark begins wide on the front of 2, narrows to the hump on 3, still narrower on front of 4, whence it widens through 5 and 6, and at 7 begins to descend the side rapidly, sometimes to the spiracle level, but goes up again, at 8 descends in a squarish patch enclosing the spiracle, and then ascends again, at 9 begins at the level of the spiracle, but slopes rapidly up to the back, very narrow at 12, thence widening on 13, but afterwards growing narrow once more. The colour of this saddle varies; in one example it was lilac, with some pale streaks in the centre, and on 6—8 at its widest it contained on either side a rich yellow patch turning to orange, with some lilac slanting lines; all along bordered with a fine bright red line, and outside that again with a yellow line; in another larva the saddle was deepish purple with a mealy freckling, the patch at the wide part fiery orange-red, with purple slanting streaks; the saddle bordered with a line of dark purple, then vivid crimson, and lastly bright yellow. The larvæ on approaching full growth had the dorsal saddle much tinged with greenish, and the yellow and crimson and purple marks not so vivid. The head claret-brown in front, darkest on the top, greenish at the sides, mouth purple, the

side below the saddle-edging rich yellow-green deepening downwards to rich full green; above the spiracles a few irregular, yellowish small spots and some small, dull red spots, the spiracles brownish with darker rings, with some yellow-ringed red dots about them; below the spiracles two irregular lines of small elongated yellow spots, and below them a row of yellow-ringed red dots, four on each segment; along the level of the legs an irregular red-brown streak edged with yellow, which sends a slanting mark down the back of each ventral proleg; thoracic legs shining reddish with a green ring, ventral prolegs green with pink feet, a central ventral purplish-red stripe on 12 and 13; the tails lilac with two greenish rings; altogether this is an exceedingly rich-coloured larva, and hard to describe properly.

The cocoon is made of a strong cement of silk, thoroughly mixed with bits of the wood or bark on which it is fixed, so as to assimilate closely to the surrounding surface. I have cocoons placed on pieces of touchwood, and one cut from willow bark; for the latter, the larva had gnawed out an oval hollow, and worked in the bits of bark, lichen, &c. I have measured two of the others, which look like long oval swellings on the flat face of the decayed wood (this swelling would not be found in the natural position of a cocoon—some depression in the bark of a willow tree), one being about 27 mm. in length and 10 mm. in width, the other not 20 mm. long, and 8 or 9 mm. wide; in each case a neat hollow is gnawed out of the surface, and the materials thus obtained strongly cemented together until the outer wall of the cocoon feels quite hard; the inside looks glossy, but is not very smooth.

One pupa measured 17 mm. in length, another only 14 mm.; the figure cylindrical, of almost even bulk throughout, except at the last two segments of the abdomen, which taper a little; both ends blunt but rounded, especially the tail, which is very smooth, and,

instead of a spike, has a little pit in the middle; the pectinated antenna-cases distinct, though not prominent, the skin dull except at the tail, which is quite glossy; the colour deep red-brown, the wing-cases having a tinge of green. (J. H., 10, 12, 86.)

CERURA BIFIDA.

Plate XXXII, fig. 3.

This larva was figured by Mr. Buckler August 20th, 1868, on aspen, and the imago bred June 12th,1869. In 1858, I had two full-grown larvæ, August 7th, and bred the moths June 2nd and 4th, 1859. In 1868, I had a small larva on aspen, June 30th. In 1870, I bred moths on May 12th and 14th. Several times I found cocoons on the bark of poplar trees; though exactly of the tint of the bark, they could be detected by their filling up a crack; they were hard to be removed from the trees without injury to the enclosed pupæ.

In 1886, I received some larvæ on poplar from Mr. G. T. Porritt, August 11th; these began to spin August 17th. Mr. W. H. Harwood sent me some larvæ August 28th, which began to spin on the 30th.

The full-grown larva is nearly 35 mm. in length, stouter than *furcula*, the face flat, head retractile, the front of 2 squared, with a rough spot on either side, and the back of 2 somewhat horny, the body from 10 tapering backwards to a point, the tails rather rough, 6 or 7 mm. long; the dorsal mark begins broad on the front of 2, narrows to the dorsal hump on 3, where in some examples it stops bluntly, (leaving the front of 4, and sometimes all 4 and front of 5, of the green ground colour), and beginning again very acutely on 4 or 5, and widening till at 7 it either reaches the spiracle level, or else encloses the spiracle, and then narrows again, always widens and encloses the spiracle

on 8, and then contracts, either touches the spiracle or encloses it on 9, then slopes up and becomes narrow on 12, widening out again on 13; the colouring, as in *furcula*, is very rich; the dorsal mark brownish with a lilac bloom on it (growing mealy lilac as the larva approaches maturity); there are traces of a thin, pale dorsal line through it; on segment 8, and sometimes on 7, 8, and 9, it contains on either side some orange or yellow blotches irregularly triangular with the broad end in front, sometimes also there are other and smaller yellow spots on these segments, the saddle-mark edged first with red or purplish-red, and then more broadly with yellow; the sides and belly rich green, set above with some small yellow dots, and below with yellow-bordered red dots, the spiracles brownish-red and enclosed in small reddish spots; on 3 or 4 are faint yellow false spiracles; the face brownish, with the top of the lobes black, the mouth lilac, the neck pinkish, the rough spots on front of 2 brown, thoracic legs greenish with red joints, the ventral prolegs with a small yellow-bordered red streak, and a red half-moon above the foot, a double purple ventral line on 12 and 13, wider on 11, and joining the streaks on the prolegs of 10; the tails roughish, green above, lilac below, with yellow rings, the whips when protruded seem purplish; the red dots on the sides bear little bristles; at the tip of the anal flap are two sharp points, and another pair underneath, which are used to throw the pellets of frass to a distance.

The larva makes its cocoon on the bark of the poplar tree, a yard or so from the ground, gnawing out a hollow, and mixing the gnawed bark with silk. I have several cocoons, some cut from trees, others made on touchwood; they vary in length from 25 mm. to 30 mm., and in breadth from 8 mm. to 12 mm; those on bark are adapted in shape as well as colour to their surroundings; one on touchwood is beautifully oval and regular in outline; the most curious is

one made by a larva during a journey in a tin box; it had nothing but a poplar twig not 3 mm. in diameter, but it attached itself to this, and spun a cocoon in form much like that of *Anthrocera* on a grass stem. The pupa seems of the same form and colour as that of *furcula*, only larger. I should say that in nature the pupa stands upright in every species of *Cerura*, and that the exit of the moth is accomplished by some softening of the upper part of the outer shell of the cocoon, so that it forces its way through a round hole of some size, leaving the empty pupa-skin within the cocoon.

I have some old eggs of *bifida*, which are of the same form and structure as those of *vinula*, but 1·3 mm. in diameter; they are dark brown *now*, but what their colour was when fresh I cannot say. (J. H., 11, 12, 86.)

Cerura vinula.

Plate XXXII, fig. 4.

Mr. Buckler figured this larva in August, 1858, on black poplar; the figures 4, 4, *a*, and 4, *c* represent the same individual in three stages of growth, May 29th, June 18th, and June 27th, 1867; unluckily 4 represents the larva preparing for its first moult, with the new head already formed under the skin, and distorting the position of the little horns on the front of 2; they are close to the head until thus thrown back out of place.

Out of a great number of notes in different years I extract the following:—I have bred the moth as early as April 26th, and on to June 15th; I had eggs laid May 25th, and the larvæ hatched June 4th; eggs laid May 27th, larvæ hatched June 7th; and I have a record of larvæ hatched fourteen days after the eggs were laid. In 1886 I had larvæ hatched June 9th, which began to spin July 24th, an interval of rather more

than six weeks ; and I found an egg July 7th, the larva from which hatched July 17th, and which, had it thriven, would have lived on through August. This year also Mr. G. T. Porritt sent me both eggs and larvæ, Mr. G. C. Bignell sent me larvæ, and Mr. W. H. B. Fletcher sent me eggs.

The eggs are laid either singly or two or three near together, on leaves of poplar, sallow, or willow (I fancy poplar—any kind—is preferred by the larvæ when they have the choice); the egg is button-shaped, convex above, nearly flat underneath, fairly round, with a small pit at the apex, varying from 1·6 mm. to almost 2 mm. in wide diameter, slightly more than 1 mm. high, the shell hard, glossy, but finely pitted all over ; colour rich warm brown above, more smoky beneath, the central pit blackish but ringed with yellowish-white. There is a pale variety of the egg of a buff tint, the central pit still blackish, with light ring. Mr. Fletcher has noticed the likeness between eggs of *vinula* and the little fungoid buttons seen on sallow leaves. The young larva escapes by a round hole close to the central pit, and this hole is the only mark of its being hatched ; it is a queer little creature, 3·5 mm. to 4 mm. long, its tails 3 mm. long, the warts on 2 projecting over the head like horns, the skin smooth, the places of the usual dots marked by small hairs, the ventral prolegs very large. The whips from the tails can be protruded to nearly the length of 2 mm. ; the colour intense sooty-black above, black with claret-red tinge below, the whips carmine red ; some examples have their horns and tails tinged with ferruginous. I have noticed that sometimes just the edges of young poplar leaves turn black and wither, and it struck me that the newly-hatched *vinula* on the edge of a leaf must look very like a small patch of such a withered edging. The larva is more irritable when young than afterwards, and when disturbed curves its tails over its back readily, and protrudes the whips ; as it grows there comes something like a line dividing the colouring

of the back from that of the lower parts, much as Mr. Buckler's smaller figure shows it, only that figure is enlarged, for the larva is not more than 7 mm. long at its first moult. Immediately after this moult the back is blackish-brown, and the lower parts claret coloured, with a yellowish lateral streak on 3—5 and 10—12, which is in fact the commencement of the future general green colouring; before the second moult the sides have become rich yellow, with purplish-brown streaks. The second moult comes when the larva is 9 or 10 mm. long, and immediately after, the back is rich velvety brown, and the sides bright yellow, with only a spiracular stripe of reddish, the horns still long and set with rough points, the tails 5·5 mm. long; with further growth the brown of the back becomes lighter. The third moult comes when the larva is 15 mm. long; this moult brings the tails to the length of 8 mm.; the horns are still prominent and set with points; the brown dorsal saddle now shows some yellow freckling, and is bordered by a brown line and an outer yellow line, and the saddle-flap on 8 goes below the spiracle. The rest of the body is now rich green, the spiracles black, with yellow centres; after this there are two moults more (in all five moults, at intervals of five or six days), but I have not all the details of the fourth. The fifth comes when the larva is rather less than 30 mm. in length, and leaves it at first perhaps as quaint in appearance as at any time of its life, its head and tails being full-sized, while the body has not yet its due proportions; the horns are gone, and their places marked by dark velvet spots. Dr. Chapman watched a moult more than once, and gives some interesting observations; the larva creeps out from the opening in front of the old skin, but for the hinder segments and tails it clears them from the old skin by raising them, and then dragging out the tails, and just as the tails are free the whips can be seen completing their moult also, and retiring into the tails. The dragging out of the tails seems to pull the whips to

their full length before they disappear. During the moult there can be plainly seen an extra tracheal thread from between the third and fourth segments. When the larva is free from the old skin it scrapes off the old headpiece by pulling it against the edge of the leaf on which it is fixed, and then turns round and places itself in position as if to begin at once eating the cast skin; but this is not done for some hours. As I mentioned before, Dr. Chapman found that the leaf on which the moult took place was also eaten up, and he considered this was done for the sake of the silk spinning on it, which in some way is good for the health of the larva. The full-grown larva is more than 60 mm. long when stretched out, and in that position the head and the hump on the back do not look so large and conspicuous as when the larva is at rest and contracted. The body is stout, with the hinder segments tapering to a point, a transverse dorsal hump on segment 4; the tails, 10 mm. long, set with short points; the face is somewhat flat, the head retractile into segment 2, which thus becomes puffed. On the back of 2 is a sort of shiny plate, slightly pitted, very wide and squared in front, and rounded on the hinder edge; the anal flap has a plate, and it ends in a small pair of points. Below the anus is another pair of points; these points receive the pellets of frass and jerk them to a distance. From the tails can be protruded two filaments or whips, but as the larva grows large it is not easily excited to do this; their use has been supposed to be for defence against ichneumons, but I have taken full-fed larvæ which had rows of ichneumon eggs fixed on the back and sides in the folds between the anterior segments. Under the mouth, at a distance of 2 mm. from the head in the skin-fold, and about 1 mm. in advance of the front pair of thoracic legs, is a transverse cleft, 3·5 mm. wide, the mouth of a cavity which contains a quantity of clear fluid, but of the nature and use of this fluid I cannot speak. In the coloration there is a sharp division between the

back and the lower part of the body; the dorsal mark begins wide on the front of 2, narrows thence with a straight slope to the hump on 4, then widens with a straight slope through 5 and 6, and on 7, 8, and 9 varies a great deal, being at its widest on 8; through 9 and 10 it slopes up again, on 11 has nearly parallel sides, widens through 12 to the front of 13, and then narrows back to the flap. This summer I reckoned six good variations in the flaps and stirrups of the dorsal saddle; the simplest form had the saddle swelling out with a gentle curve on 8, but did not come so low as the spiracle by more than 1 mm. The next form to this had the saddle on 8 extended in a sort of obtuse angle to just the level of the spiracle, but no further; then there was a form in which the flap came just below the spiracle, and below it, quite on the leg, a somewhat rounded spot or stirrup, but without any connecting link. Then there was the form in which the saddle-flap came as low as the spiracle, and continued down the side, quite narrow at the spiracle, but swelling out into an irregular blotch or stirrup on the leg. Then there was the form with this flap and stirrup on 8, and on 9, below the spiracle, a large three-lobed spot; and, lastly, the form showing the greatest development of the saddle which I saw, with the flap on 8 covering all the side of that segment except just a small spot by the spiracle, and reaching down into the leg, and on 9 a similar but narrower flap reaching nearly as low; in no case did I see the spiracle, either on 8 or 9, enclosed in any extension of the saddle-flap. This dorsal mark varies in depth of colour, always growing paler as the larva matures. It has a greenish tint on the front of 2, and after that, it is brown, more or less tinted with purple or lilac, and more or less freckled in long streaks of greenish-white. (Dr. Chapman tells me that on the Continent this summer he saw larvæ paler in this way with white brindling than he had ever noticed at home.) The border of the saddle is darker in tint, and so are the flaps and spots on the

sides. The saddle has a distinct white line as an edging, but this becomes more yellow round the flaps and spots; the hump on 4 is coloured pink on the sides; the sides of the larva are rich green, of a somewhat yellow-green tint; the belly full green, with a purplish-brown streak on 5—7, and two purple-brown marks on 11—13; on 11 and 12 a pair of purple spots, on 13 two pairs. The face is brownish-buff, the lobes bordered with black, the mouth black, the fold of the neck rose-pink all round, the places of the horns are two velvet black spots; the spiracles white ringed with black, and segments 3 and 4 have indications of false spiracles; the thoracic legs black, with two yellowish-green rings, the ventral prolegs green, with black transverse marks halfway down, and some brown bristles on the lower mark; the tails are pale-green set with black points; the whips are pink.

When full-fed the larva assumes a sad brown tint, and if supplied with wood will soon set about its cocoon. I have found the cocoon on the bark of poplar trees, and once I took a cocoon, which I still possess, from a stone wall close to a poplar tree; the stone was a coarse red sandstone, and the cocoon, thinner than usual and not so hard, was coated all over with little bits of this. I have also a cocoon made on cardboard, but this is very stout and hard; those I have on touch-wood are very hard, being more than 2 mm. thick in their substance, besides the outer covering of bits of the wood. This summer I watched several larvæ making their cocoons. Having chosen a spot on the wood, a larva would begin by spinning some coarse sticky threads in a random manner from side to side; it then appeared to get its head under them, and to bite out with a jerk little bits of wood and stick them here and there on the threads. In this way it would proceed until just half the body was covered with a loose tangle of threads and bits of wood, from half an hour to three quarters being the time thus spent; it would then turn its head to one side, and commence widening the base

of operations, working backwards until it had quite doubled on itself, the head and tail being at one end, and the middle of the body at the other end; the cocoon inside being thus just half the length of the larva. This widening did not take so long as the first portion, and in making it the larva would sometimes burst the earlier spinning. When the whole body was thus covered the larva proceeded to fill up the openings in its spinning, partly by more bits of wood gnawed from beneath, and partly by smearing its sticky silk, which, as far as I could see, came entirely from the mouth, or from near the mouth. One larva had completed a perfect coating in four hours, but it was still soft and yielding; in nine hours from the commencement the cocoon was tough and firm, though not very hard; in four and twenty hours it had become quite hard. Thus rather more than half of the cocoon is an oval pit gnawed out of the wood, and the outer side is a somewhat swelling oval formed of chips and silk; the whole of the interior is lined with this silk, looking as if varnished, especially at the ends, although the surface is not very smooth; the general measurement outside is about 40 mm. in length and 25 mm. in width. The pupa is short and stout in figure, full 30 mm. in length, and 13 mm. across at the widest part of the abdomen; the head a little prominent, the eyes prominent, the antenna-cases distinct though not prominent, the waist a little sunk at the back and sides, the abdomen swelling out, and tapering in a curve to the rounded tail, which has no spike, but the whole of its surface is set with several rough points, and it has a slight central depression; the divisions of the abdominal segments are well cut; the skin generally is rough, but the segmental folds smooth; the colour dark brown with a tinge of purple-red.

I may add that once I had an example two winters in the pupa state; most of the brood appeared as moths in the May of the year following that in which they were hatched, but this individual did not emerge

until the April of the year after that. (J. H., 17, 12, 86.)

Notodonta dromedarius.

Plate XXXIII, fig. 2.

Mr. Buckler figured this species, August 9th, 1860, on birch; and August 18th, 1868, on birch also. In 1858 I bred several moths, May 25th to June 1st, from pupæ found during the previous winter at the roots of alders; in 1862 I again bred moths, May 11th to June 6th; in 1870, August 25th, I beat the larva from alder not half grown; in 1871, August 7th, I again beat the larva from alder, and bred the moth July 15th, 1872. In 1886 Mr. Bignell sent me a larva on alder quite small, July 17th; it moulted on July 22nd, being 20 mm. long, but soon after died, because, as I believe, I could not supply it with alder; whilst with me it ate birch, but not heartily. August 4th, Mr. Bignell sent me another larva, I suppose full grown, being rather less than 35 mm. in length. September 2nd, Mr. W. H. B. Fletcher sent me several larvæ and supplied me with alder for their food; the smallest of them was but 15 mm. long.

This larva varies a good deal in colour; when about its last moult it seems to be most brilliantly coloured. One at this stage, described this year, was brilliant yellow all over, except the purple-brown dorsal mark and brown head, the belly also brown except some green patches between the legs; afterwards there came some vivid green marks on segments 9—11 and a subdorsal row of green slanting streaks on 6—11; the purple-brown dorsal mark included the humps, but their tips were yellow. This was a very handsome larva; others were more or less of a dusky yellow-brown all over. The one I described most carefully was over 33 mm. in length, with very irregular outline, especially when at rest, the back being then humped and the hinder

segments thrown up in the air; the head slightly wider than segment 2, set on at a slant, the lobes separated so as to show a small notch on the top; segments 2—4 narrower than the rest; on 5, 6, 7, three dorsal humps, like saw-teeth, pointing backwards, the dorsal hump on 8 smaller and more upright; on 12 a tall, straight dorsal hump; segment 13 sloping away rapidly, the anal prolegs small and peg-like, the ventral prolegs well developed; the skin soft but much wrinkled; colour on the upper part of the body opaque yellow, a pinkish-purple broad dorsal stripe on 2—4, also colouring the folds and humps on the following segments and ceasing with the hump on 8, the humps on 5—7 spotted with white on their sides. Along the side are slanting streaks of rich green, just above the spiracles the whole ground becoming rich green. About the middle segments the colour round the spiracles yellow, but the front segments all green below; the belly on 5 and 6, and on 11 and 12, purplish-brown, and 7—10 with a purple-brown broad streak just above the legs; thoracic legs brown with green rings, ventral prolegs mottled green and brown; the head pinkish-brown with black dots; the spiracles with whitish centres, black rings, whitish outer rings, and brownish bordering outside; the general effect of the colouring very rich. Owing to the wrinkling of the skin there are no distinct lines, but the various colours are more or less mottled. I have had larvæ of less brilliant general hue but with irregular patches of brilliant green, differing in shape on the two sides.

The great feature of this larva is the row of *four* dorsal humps; *tritophus* has *three*, and *ziczac two;* they are alike in their habit of holding up the small anal prolegs, which from their size and shape do not seem meant to be of much use.

The larva spins an oval cocoon of tough, shining, yellowish-brown silk, covered all over with bits of earth; I measured one, 25 mm. long and 15 mm. wide; the pupa I measured was just 20 mm. in length, stout,

quite cylindrical, smooth, the tail rounded, without a spike, but with what might represent the end of a spike, namely, two tiny diverging groups of rough points; the skin rather glossy, in colour deep rich red-brown. (J. H., 20, 12, 86.)

Notodonta ziczac.

Plate XXXIII, fig. 4.

Mr. Buckler's note on this species is as follows: "Feed on willow and sallow, two broods in the year, reared the above from eggs received from G. Gascoyne, Newark, 1857." His other date is June 11th, 1868.

I have bred the moth in various years, April 26th to May 18th, again May 26th, June 9th, July 11th and 14th. I found four eggs on sallow May 20th, 1868, the larvæ hatched May 27th, and I bred the moths in the second week of July, thus confirming Mr. Buckler's note on the double-broodedness of this species. In 1874, August 19th, I found two larvæ on willow, and bred the moths May 26th and June 9th, 1875. I have also the record of a larva taken September 14th, 1861. In 1886 Mr. Porritt sent me eggs June 9th, the larvæ hatched June 13th, moulted twice or thrice, but died early in July. July 17th, Mr. Porritt sent me a second supply of eggs, but somehow I could not get the larvæ to full growth. August 4th, Mr. Bignell sent me a larva 20 mm. long, and August 6th Mr. Porritt sent me two larvæ, so altogether I was able to describe one or two varieties.

The egg is what is called button-shaped, slightly domed above, and flat below, just 1 mm. wide, and 0·7 mm. high, the shell dull, very finely granulated; colour at first whitish-green, afterwards dead white, with a faint leaden tinge where the dark head of the larva shows through. The young larva makes its exit by a large hole in the side of the egg, but does not eat the shell; it is not quite 3 mm. long, with a large

black head, much wider than the second segment, with the face somewhat heart-shaped and broadest above; there is a small dorsal hump on 12, the rest of the body smooth; the body yellow, the head and narrow collar on segment 2 black, a narrow brown stripe on the back, the tubercular dots small, black, but some of those near the tail larger, each bearing a short black hair. After the larva begins to feed, a greenish tinge comes over the body; at first the larva gnawed only one side of a willow leaf, leaving the opposite skin and all the ribs untouched. The first moult comes in about six days, and at once develops the characteristic shape of the larva. The length is about 7 mm., the head is still larger than the front segments, there is a sharp dorsal hump on 6, and a smaller one on 7, and a pyramidal hump on 12; the colour I noted as whitish-grey, a broad, darker dorsal stripe on 2 to 6, thence a thin dorsal line widening again on 12; on 2 and 3 a yellow spiracular stripe; some short dark streaks on the sides, the belly dusky. The second moult comes in about six days more, the length about 12 mm., the figure and colouring more developed, some larvæ showing a pink tinge.

The full-grown larva is generally handsome, but varies a good deal in colouring; I have short notes of one which was lilac above, dark brown below, the hump on 12 orange-red with yellow streaks, a yellowish line along the spiracles. The variety I described most fully was paler; the length 40 mm., the body stout, more slender in front, the head wider than segment 2, and in height also rising above it, notched on the crown; the front segments somewhat flattened; on 6 and 7 saw-toothed dorsal humps, larger on 6, smaller on 7; on 12 a square pyramidal hump; the ventral prolegs strong, the anal prolegs small; the colour mostly a mixture of pale delicate grey and pink; the head pale stone colour; a dorsal patch of orange edged with brown on 2—4; on 5, and again on 8—11, a grey dorsal line; the hump on 6 orange-brown, on 7

darker; the latter half of 10, including half of proleg, and the whole of 11 and 12 rich orange, with white lines at the top of the pyramid on 12; 13 pink and grey; on 5—10 pale yellowish lateral slanting streaks; the spiracular region grey; spiracles pale with dark rings; below them the colour is dusky pink, the belly more dusky.

Another variety was altogether paler, with little or no pink tinge, the sides whitish tinged with a little pale yellow, the humps white and grey, segments 11 and 12 with a very few orange freckles.

I have no cocoon measurements: I believe the structure of the cocoon is not so strong as that of some other "Prominents." The pupa I measured is barely 20 mm. long, cylindrical, of nearly even bulk, the abdomen tapering but slightly, the tail rounded, with no spike, but some roughness at the end, and two tiny divergent points; the skin dull on the wing-cases, glossy on the abdomen, very glossy on the last segment; colour dark red-brown. (J. H., 21, 12, 86.)

Pterostoma palpina.

Plate XXXIV, fig. 1.

Mr. Buckler figured this larva July 9th, 1861, and described its appearance as "rather granulous;" and again July 11th, 1868, on poplar. When I began collecting I had moths brought to me from the street lamps at various dates, May 27th being the earliest, August 18th the latest, intermediate dates June 4th and 6th, July 1st, 26th, 29th, August 2nd, 13th, and 17th. In 1861 I had eggs June 3rd, the larvæ hatched June 13th, had all spun up July 15th, and I bred a moth April 14th, 1862. I have taken the larva from aspen June 30th, from sallow July 14th, September 16th.

Mr. W. H. Harwood tells me he has frequently bred two broods in the year, but the second flight is always

more or less partial, leaving some of the pupæ to go through the winter with those of the next generation.

In 1886, August 24th, Mr. Harwood sent me a larva on sallow, full-fed, which began to spin next day; September 22nd Mr. G. T. Porritt sent me some larvæ, one of them in its last moult.

I have no description of the egg, or young larva; only a note that it fed away on a sallow leaf, eating both sides to the midrib, which it left untouched, and used as a resting place. The last moult was passed when the larva was 22 mm. long, the previous appearance had not differed much from the new coat. The full-fed larva was full 30 mm. in length, stout and stiff in figure, tapering a little forward from segment 8; segment 13 sloping rapidly; head smaller than any other segment, its lobes rounded at top, flattish in front; skin much wrinkled transversely, apparently six folds in each segment; in colour very pale bluish-green, the middle of the back of the ground colour, on either side of this a stout opaque white line beginning on the head, below this a similar but narrower subdorsal line; these four lines, which look raised and warty as it were, converge, but do not meet on the anal flap; above the spiracles a line, which is white on the front of each segment and yellow on the hinder part, and is very distinctly, but very finely, edged above with black, and on segments 2—4 bears some lilac spots; this line ends under the anal flap in two blunt points; the head green, its lobes edged white on their inner outline; the spiracles whitish; the skin of the belly wrinkled, but glossy, and of a fuller green colour than the back. The larva spins a weak cocoon of greyish silk amongst loose earth, but not so much coated with earth as the cocoons of some other species. The pupa 18 mm. long, stout, cylindrical, back of thorax rounded, head a little produced, abdomen somewhat tapering, segmental divisions well cut, tail diminishing in a curve with rounded end, having a short curved blunt spike just 1 mm. long, much wrinkled, and set with four points,

one or other of which seems to be undeveloped in each example; skin glossy, colour dark brown. (J. H., 31, 12, 86.)

PTILOPHORA PLUMIGERA.

Plate XXXIV, fig. 2 (see *ante*, p. 73).

To Mr. Buckler's description of this larva I wish to add some notes, made by Dr. Chapman's help, of a curious appendage, which was discovered by Mrs. Fletcher while inflating an empty larva-skin. The position of this appendage is between the head and the first pair of thoracic legs, and the first sight of it suggested an extra pair of legs; in form it is a transverse projection, somewhat sausage-shaped, free at the ends, which bifurcate into two narrower processes, the posterior of which is longer and thinner than the anterior; the tips of these processes are rounded, and they are studded, especially at the tips, with fine hairs; these ends project laterally beyond the body of the larva, and ventrally beyond the legs. Mr. Fletcher tells me that when a larva of *plumigera* is irritated by being touched, it turns its head round and strikes angrily with this appendage at the irritating object, but he could not detect what the effect of this action would be. Dr. Chapman is inclined to think that this organ corresponds to the slit in the larva of *C. vinula* mentioned at page 146. Mr. Fletcher has found a somewhat similar appendage in *P. nubeculosa*, and Dr. Chapman has noticed a slight raised ridge in an inflated larva of *Gluphisia crenata*, and possibly there are others similarly furnished. (J. H., 28, 12, 86.)

Drymonia chaonia.

Plate XXXIV, fig. 3.

Mr. Buckler figured this species June 19th, 1861; June 18th and 23rd, 1863; July 3rd, 1871, and bred the moth May 1st, 1872; the food of the larva in each case was oak.

I used occasionally to find the pupa, and oftener to beat one or two larvæ from oak trees; I find all my recorded dates of the emergence of the imago lie between April 11th and 30th; my dates of the capture of the larva vary from May 9th to June 25th. In 1886 Mr. Bignell sent me a pupa July 14th; and he sent me a small larva July 17th, which continued to feed for just a month, but died without changing. When first received it was 12 mm. long, and except that it was slender in figure, had much of the adult appearance; it moulted July 23rd and ate the old skin; it moulted again August 3rd, when about 20 mm. long; it grew to be about 35 mm. long, of even bulk nearly throughout, but tapering a little behind; the head sloped forward, somewhat rounded, the skin wrinkled with six folds in each segment, the front fold being the widest; the colour of the back blue-green, through which ran two opaque yellow lines; at the subdorsal level a row of irregular yellow spots (when smaller the subdorsal line was continuous, and the pulsating dorsal vessel could be seen). Above the spiracles a strong yellow line, on its lower edge the pinkish spiracles ringed with black, and each followed by a white spot; in segments 2—4 this supra-spiracular line has a little pink tinge, and in 13 it runs round the anal flap; the head pale green, rather shining; the belly wrinkled, glaucous green. The cocoons I found were not distinguishable by me from those of *D. dodonæa*; those taken from fine dry soil in the angles of the roots of oak trees were of regular outline, tough in fabric, covered evenly with bits of earth. Mr. W. H. Harwood tells me he knows

the cocoon of *chaonia* by the brownish-golden colour of the silk lining and also by its larger size and greater strength; the pupa I measured was 13 mm. long, stout in figure, swelling out widest at the abdomen, otherwise cylindrical, the tail rounded, without a spike but with two little bifid warts; the colour deep mahogany-brown, rather glossy. (J. H., 28, 12, 86.)

Drymonia dodonæa.

Plate XXXIV, fig. 4.

This larva was figured by Mr. Buckler September 9th and 12th, 1867, and he bred the moth June 12th, 1868; he figured it again August 12th, 1871.

In 1857 and 1858 I found several pupæ at the roots of oak trees, and bred the moths in 1858 and 1859, from May 14th to June 3rd, but I never could find the larva; the food is always oak.

Mr. Harwood tells me the larva has a superficial resemblance to that of *Lophopteryx carmelita*, and that there are two varieties, one with a yellow spiracular line, the other with a reddish line; the general colour is pea-green. The cocoon I measured is of a toughish fabric of silk, well covered with fine earth, about 20 mm. long and 8 mm. wide, regularly formed; the pupa is not so stout as that of *chaonia*, but is rather more glossy. (J. H., 29, 12, 86.)

Leiocampa dictæa.

Plate XXXV, fig. 1.

Mr. Buckler figured this species from poplar August 16th, 1860, and June 17th, 1867; he bred the moth from the latter larva July 30th, apparently, therefore, obtaining a second flight. The question of the double-broodedness in England of several species of "Prominents" was hotly debated some years since, when

Mr. H. Doubleday gave it as his experience that not one species could be *properly* called double-brooded, the appearance of a few examples of a second flight being accidental; however, Boisduval says distinctly that *dictæa* and *dictæoides* are double-brooded on the Continent, and Mr. Harwood, who has had great experience in larva-rearing, prefers to call both these species double-brooded in this country. I have never taken *dictæa* myself, but in June, 1860, I had two batches of eggs given me, the larvæ from which hatched June 27th and July 19th, and I bred the moths June 13th to July 1st, 1861. In 1866 I bred a moth March 22nd, but have not recorded any special circumstances that might have caused this early emergence. In 1886 Mr. G. T. Porritt sent me some larvæ September 16th and 24th, all in their last skin and nearly full-fed, and by the end of the month they had spun up.

The full-grown larva is fully 40 mm. in length, and has an elongated appearance; the head is notched on the crown, and is rather deeper than segment 2, with rounded outline and very glossy; the skin is like shining leather; on 3 a sort of fold, swollen laterally, on 4 a smaller lateral swelling; on the back of each segment 5—10 what may be called an attempt at a transverse hump, those on 5 and 6 being smaller than the rest; on 12 a pyramidal hump extended laterally; the anal flap looks granulated, the ventral prolegs strong, the anal prolegs small; in colour I had two varieties; one whose general tint was drab, with a transverse patch of warm brown on each segment 5—12, 13 altogether brown, on 3, and again on 6—10 a purplish streak edging the hinder part of the brown patch on either side, spiracles conspicuous, being black with small white centres and with strong white rings, the centre of the belly pale yellow, the head delicately reticulated with a pattern of lilac, buff and brown, the thoracic legs red, the ventral prolegs brown with a purple stripe down them (before the larva became full-fed the brown colouring had a red

tinge, and was more defined; on 7—10, the transverse brown patch edged behind with a black line); the places of the usual dots marked with tiny hairs. This variety was wonderfully like a twig of aspen, on the leaves of which the larvæ were feeding. The other variety was opaque yellow-green on the back, fuller green on the side, the swelling on 3 bluish-green, on 6—9 faint brownish transverse marks, the hump on 12 whitish with a fine transverse line of dark green, a strong sub-spiracular line of yellow, the spiracles surrounded with pale brownish; the head green, slightly freckled with brownish; the belly green with yellow middle; thoracic legs brownish, ventral prolegs green, tinged with brown outside. The larva makes a large cocoon of grey silk, well covered with loose earth; the pupa which I have measured is 20 mm. long, blunt at the head, cylindrical, the waist a little sunk at the sides, the abdomen not diminishing much in bulk, three of the abdominal divisions cut deeply, the last segment conical but rounded, with no spike, but with two small diverging sharp points set wide apart; the wing-cases shagreened, the rest of the skin glossy; the colour deep mahogany-brown, darker on the head and thorax. (J. H., 29, 12, 86.)

Leiocampa dictæoides.

Plate XXXV, fig. 2.

Mr. Buckler figured this species September 15th, 1860, August 28th, 1868, and July 26th, 1869; from this last example he bred the moth October 11th, 1869; all the larvæ were from birch. In 1860, September 11th, I had larvæ given me, and again August 6th, 1868, but I never got one to complete its final change; in fact, I have formed the conclusion that this species is not easy to rear. In this country the usual time of the flight of the moth is the month of June and again in August and September. In 1886,

June 29th, Mr. C. G. Barrett sent me eggs; the larvæ hatched July 4th, moulted July 20th, but died soon after. On September 10th Mr. W. H. B. Fletcher sent me some larvæ, mostly full-fed, but I could not persuade them to become pupæ. September 18th Mr. F. N. Pierce, of Liverpool, sent me some larvæ. The food is birch, though I noticed one larva which came to me feeding on sycamore; the egg is of a flat button shape, about 1·2 mm. wide and 0·5 mm. high, the upper surface most minutely granulated, with a small smooth spot on the top, in colour dead greenish-white; the flat under surface smooth, shining, in colour full green. The newly hatched larva is just 2·5 mm. long, with a large jet-black head, a narrow jet-black collar on 2, a slight dorsal hump on 12, colour translucent white, with an internal blue-green tinge in front, and a patch of yellow-green on 11 and 12, usual dots small and black, each with a short black hair. In four or five days time the head has become shining brown, the back and belly pale purple, the sides pale yellow, the tip of the hump on 12 black. At first the larva eats the under surface of a birch leaf, but before the first moult eats holes through its substance. When 20 mm. long the larva is reddish-claret on the back, with a dull olive tint on the middle of each segment, the hump on 12 deep purple, the spiracular stripe pale yellow; on segments 2 and 3 the warts enlarged transversely, so as to give the effect of a fold; on 12 a large fleshy tail-like hump pointing backwards. The full-grown larva is 35 mm. in length, with the figure slender, the shining head larger than 2, flat in front, but with rounded sides, the skin very glossy and leathery looking, very smooth on the back, wrinkled at the sides; on 2 and 3 a sort of dorsal fold, on 12 a dumpy transverse hump with a round central prominence, the anal flap roughly shagreened; in colour the back is lilac varied with dull olive, a red tinge on the sides, the fold on 3 deep purple, the hump on 12 black with a black streak on each side running down to the spiracular line; the

broad spiracular stripe rich brilliant yellow, the spiracles black in white rings; the head brownish-lilac beautifully reticulated with whitish, the belly purplish with yellow central stripe, thoracic legs red, ventral prolegs purple, anal flap reddish-brown; in all stages this is a very handsome larva.

Mr. Harwood tells me the cocoon and pupa resemble those of *dictæa*, except that they are of smaller size. (J. H., 29, 12, 86.)

Lophopteryx camelina.

Plate XXXV, fig. 3.

Mr. Buckler figured this species August 24th, 1859, September 12th, and November 13th, 1860, September 20th, 1867; the only food he mentions is poplar.

I have bred the moths from pupæ found at oak trees from April 26th through May and June, up to July 10th; in 1861 I bred the moth July 28th from eggs of the same year; in 1863 and 1870 I beat larvæ in the third week of September; altogether, I suppose this is more completely double-brooded than most species of this family. I have found the larva on oak, alder, and hazel. In 1886 Mr. W. H. B. Fletcher and Mr. G. T. Porritt both sent me larvæ on September 10th, and on the 15th I received some from Mr. W. H. Harwood, these all spun up before the end of the month.

I have no notes of the egg or young larva. By the time the larva is 10 mm. in length it has a good deal of the adult appearance, the colours brighter than afterwards, no red dots yet on the spiracular line. The full-grown larva is about 33 mm. in length, stout in figure, tapering slightly forwards, the head much deeper and a little wider than 2; there are no humps; on 12 a pair of very prominent warts, the places of the usual dots marked by hairs; to use Albin's words,

"in repose it always lifts up its hinder part," and also throws back its front part till the back of the head and segment 2 are quite bent over segments 5 and 6. There are several varieties of colouring; one mealy whitey-greenish on the back, with the dorsal vessel like a blue thread, a subdorsal line of a faint bluish tinge, the side below more green, the spiracular line, which extends round the anal flap, yellow edged above with violet, and bearing a red spot behind each spiracle; the spiracles black, the belly green with a tinge of plum colour, and showing the usual ventral dots distinctly of a pale yellow, the head smooth, green, the mouth yellow with a black line, the warts on 12 bright red, thoracic legs pink, ventral prolegs green with red feet.

Another variety had the head and sides of a pale yellowish-pink, the back after 3 more whitey-pink, with a darker tinted dorsal thread, and at the subdorsal level a pink tint edging the back; the warts on 12 full deep pink, all the usual dots above pale, carrying short, stiff black hairs, the dots below with pale rings, the spiracular line yellowish with the red spots behind the black spiracles; the belly of a dusky apricot tint, the thoracic legs red, the ventral and anal prolegs deep pink. I have had another variety of a lilac colour.

The larva spins a cocoon of fine gauzy silk, covered with fine earth, &c.; I measured a pupa 15 mm. long, stout at the head and thorax, the abdomen tapering a good deal, the last segment diminishing in a curve, with a small straight spike tipped with four diverging tiny sharp points; the colour mahogany-brown, brighter on the abdomen. (J. H., 29, 12, 86.)

Lophopteryx cucullina.

Plate XXXV, fig. 4.

Mr. Buckler figured this species from maple August 16th, 1860, August 20th, 1866 (breeding the moth July 7th, 1867), July 10th, 1870.

In 1858, June 14th, I bred a moth from a pupa I had dug during the previous winter without recognising it; in 1861 I bred moths June 15th to 17th. In 1866 I had eggs, the larvæ from which hatched July 17th, but I have no further record of them. In 1886 Mr. W. H. B. Fletcher sent me eggs July 17th, which unfortunately proved unfertile; August 28th Mr. J. Anderson sent me larvæ of various sizes, but all in the last skin; and September 10th Mr. Fletcher sent me some full-grown larvæ on sycamore.

The egg is button-shaped, fuller than the eggs of some of the "Prominents," being 0·85 mm. wide and 0·75 mm. high, the glossy shell without any ornamentation, the colour entirely opalescent greenish. The full-grown larva is about 30 mm. long, cylindrical, tapering much from segment 6 forwards, 13 sloping rapidly, the shining head extending beyond 2 in every direction, the face flat with rounded sides, widening below, the segments distinctly marked, the skin wrinkled; on 6—11 a series of slightly raised dorsal humps, diminishing backwards, these humps slightly divided longitudinally and transversely into four small swellings, on 12 a more prominent and sharper hump ending in twin points, which are set with six hairs, the places of the usual dots marked by stiff hairs, the anal prolegs small, held up when the larva is feeding; the colour varies, one variety was greenish-white on the back, on 2—5 a broad dorsal green stripe edged with white widening backwards, and then coming to a point on 6, a green dash through the humps on 7—10, thence a green dorsal line, interrupted on 12 by the hump, a faint green subdorsal line, the sides glau-

cous green freckled with opaque whitish, the belly more green, thoracic legs greenish, ventral prolegs tinged with pink, spiracles pinkish-white with fine black rings, the head bright green with a fine blackish line through the front of each lobe, the mouth whitish; there are a few small hairs on the face.

Another variety was of a pale flesh colour, the dorsal mark purplish in front, edged with straw yellow, pale yellow freckles on upper part of sides, lower down the side more yellow with freckles of pale brownish-pink, just above the spiracles the brownish pink more decided, below the spiracles a broad line of pale yellow, then a brownish pink stripe, paler above, darker below, the belly and prolegs paler pink again, the points on 12 yellowish-pink, spiracles pink with brown rings, the dorsal dots of the front segments brown, as are also the lateral dots, but those tubercular dots which come in the brownish-pink above and below the spiracles have pale rings, and are hence very conspicuous, the head very pale greenish with a pink tinge, bearing a few brown dots, and a brown line through each lobe. Just after the last moult the colours are more vivid than when the larva is quite full grown, the yellow being deeper, and the brown-pink more decided, the hump on 12 is also more prominent, being 2 mm. in height. The larva spins a gauzy silk cocoon under loose earth or leaves. The pupa I measured was 16 mm. long, rounded at the ends, the abdomen not tapering much, tail quite smooth, with no spike or points, but with a very slightly elevated boss; the skin very glossy, the colour blackish-brown. (J. H., 30, 12, 86.)

Lophopteryx carmelita.

Plate XXXV, fig. 5.

Mr. Buckler figured this species from birch, June 27th, 1861, June 4th, 5th, 6th, 8th, 1872.

In 1861, April 29th, I had larvæ hatching, but made no further note about them. In 1864, May 11th, I had eggs given me from which the larvæ hatched May 18th, and again I made no further note. In 1872, May 11th, six small larvæ were sent to me, which by June 8th were full-fed, and spun up by June 12th; and in 1873 I bred the moths May 16th to 27th. In 1877, June 8th, I had eggs and young larvæ sent me by Mr. E. Birchall, these had spun up by July 9th; the food was birch.

The egg is button-shaped, flat beneath, the shell without ornamentation and not shining, in colour pale whitish-green, with a greener spot in the centre of the top. The young larva is nearly uniform in bulk, and in colour green with yellow lines, but the full-grown larva tapers towards either end, and is somewhat flattened in figure, more than 35 mm. in length; there are no humps, but the skin though very polished is very much wrinkled; the colour green, the lines formed of pale yellow freckles, the spiracular line yellow with red spots, the spiracles black placed in whitish spots. The larva spins a tough cocoon of dirty grey silk, stuck over with fine earth, &c., about 20 mm. long by 10 mm. wide; the pupa I measured was 16 mm. long, stout, cylindrical, the head blunt, the tail rounded off, with no spike or points, but a scarcely visible division into two lobes; the skin not very glossy, colour deep mahogany-brown. (J. H., 30, 12, 86.)

The following list of parasites, bred from the larvæ or pupæ of the species included in the present volume, has been kindly prepared by Mr. G. C. Bignell, F.E.S. —H. T. S.

Host.	Parasite.	By whom bred.
Procris Geryon	*Apanteles geryonis*, Marshall ...	Mrs. Hutchinson. J. B. Robson.
Anthrocera trifolii .	*Casinaria vidua*, Holmgren	W. P. Weston.
„ *lonicerœ* ...	*Anomalon tenuitarsum*, Gravenhorst	Weston.
„ *filipendulæ*	*Cryptus fumipennis*, Gravenhorst .	V. R. Perkins.
	Mesostenus obnoxius, Gravenhorst	W. Bennett. G. C. Bignell. E. A. Butler. E. A. Fitch. W. H. B. Fletcher M. S. Jenkyns. Weston.
	Hemiteles furcatus, Taschenberg ...	Bignell.
	Hemiteles fulvipes, Gravenhorst ...	Bignell.
	**Hemimachus instabilis*, Förster (A.)	W. H. Grigg.
	**Pezomachus analis*, Foerster	Grigg.
	Anomalon tenuitarsum, Gravenhorst	Weston.
	Rhogas bicolor, Spinola.....	Jenkyns.
	Apanteles zygœnarum, Marshall	Bignell. Grigg.
	Apanteles difficilis, Nees von Esenbeck	Bignell.
	Exorista vulgaris, Fallén	Bignell.
	Tachina larvarum, Linné	Bignell.
Smerinthus ocellatus	*Amblyteles palliatorius*, Gravenhorst	T. A. Marshall.
	Trogus lutorius, Fabricius	R. S. Edleston. Fitch.
	Microplitis ocellatœ, Bouché.....	Bignell. J. B. Bridgman. B. Brown. Fitch. Marshall. T. Wilson.
„ *populi*...	*Trogus lutorius*, Fabricius	Fitch.
	Panisous testaceus, Gravenhorst ...	Marshall.
	†*Microplitis ocellatœ*, Bouché ...	Bignell. C. Fenn.

* Hyperparasite or *Apanteles zygœnarum*.

† Mr. C. Fenn had sixty-two emerge from one larva.—'Entomologist,' vol. xviii, p. 327. Usual number from twelve to twenty.

Host.	Parasite.	By whom bred.
Smerinthus tiliæ ...	*Pimpla instigator*, Panzer.....	Marshall.
Acherontia Atropos.	*Amblyteles palliatorius*, Gravenhorst	Marshall.
	Amblyteles cerinthius, Gravenhorst	J. Scott.
	Trogus lutorius, Fabricius.....	J. Curtis.
Sphinx ligustri	*Trogus exaltatorius*, Panzer	G. T. Baker. Bignell. Fitch. G. Newport. G. H. Raynor.
	Exorista vulgaris, Fallén	Bridgman.
Chœrocampa Elpenor	*Amblyteles Proteus*, Christ	Bignell. H. D'Orville. Fitch. T. Huckett. Weston.
„ *porcellus*	*Ichneumon pisorius*, Linné	W. H. Harwood.
Macroglossa stellatarum	*Cryptus migrator*, Fabricius.....	Marshall.
Trochilum sphegiforme	*Macrocentrus marginator*, Nees von Esenbeck	W. H. Tugwell.
„ *tipuliforme*...	*Macrocentrus marginator*, Nees von Esenbeck	Marshall.
„ *culiciforme*...	*Meniscus pimplator*, Zetterstedt ...	Marshall.
	Macrocentrus marginator, Nees von Esenbeck	Harwood. Marshall.
„ *formicæforme*	*Meniscus pimplator*, Zetterstedt ...	Harwood.
Cossus ligniperda ...	*Meniscus setosus*, Fourcroy	Fitch.
	Exorista fauna, Meigen	Bignell.
Cerura bicuspis.....	*Ichneumon confusorius*, Gravenhorst	Marshall.
„ *furcula*	*Paniscus testaceus*, Gravenhorst ...	Bignell.
„ *bifida*	*Paniscus cephalotes*, Holmgren...	Baker. Raynor.
„ *vinula*	*Ichneumon multiannulatus*, Gravenhorst	Marshall.
	Eurylabus larvatus, Christ	F. D. Wheeler.
	Ophion obscurus, Fabricius	T. Eedle.
	Cryptus migrator, Fabricius.....	Marshall.
	**Paniscus cephalotes*, Holmgren	E. W. Andrews. Bridgman. Eedle. R. M. Sotheby. Wilson.
	**Paniscus testaceus*, Gravenhorst	Fitch. Fletcher. Sotheby.

* External parasites; the black eggs may be often seen attached to the second segment of the nearly full-fed larva.

Host.	Parasite.	By whom bred.
Cerura vinula (continued)	*Limneria crassiuscula*, Gravenhorst	Bignell.
Stauropus fagi	*Eurylabus larvatus*, Christ	Wheeler.
	Ophion bombycivorus, Gravenhorst	F. Norgate. Standish.
Notodonta dromedarius	*Ichneumon fabricator*, Fabricius ...	Marshall.
	Anomalon flaveolatum, Gravenhorst	Marshall.
	Apanteles abjectus, Marshall.....	Fitch.
,, *ziczac* ...	*Campoplex pugillator*, Linné	Fitch.
	Campoplex falcator, Thunberg.....	Bignell.
	Apanteles octonarius, Ratzeburg...	Bignell.
Pterostoma palpina	*Pimpla instigator*, Panzer.....	Marshall.
	Pygostolus sticticus, Fabricius	Marshall.
Drymonia chaonia .	*Lissonota polyzonias*, Forster (J. R.)	Marshall.
	Phorocera concinnata, Meigen	Bignell.
,, *dodonæa*.	*Ichneumon bilineatus*, Gmelin	G. Elisha.
Leiocampa dictæoides	*Apanteles abjectus*, Marshall.....	Norgate.
Lophopteryx camelina	*Apanteles abjectus*, Marshall.....	Bignell.
	Exorista vulgaris, Fallén	Bignell.

INDEX.

PRINTED BY ADLARD AND SON, BARTHOLOMEW CLOSE.

PLATE XVIII.

Procris statices.

1, 1 *a*, 1 *b*, 1 *c*, 1 *d*, larva after last moult.

See pp. 87—90.

Procris globulariæ

2, 2 *a*, larva before last moult; 2 *b*, 2 *c*, after last moult; 2 *d*, leaves of *Centaurea nigra*, mined and discoloured by the larva.

See pp. 1—9.

Procris Geryon.

3, 3 *a*, larva after last moult.

See pp. 91—94.

Anthrocera Minos, var. nubigena.

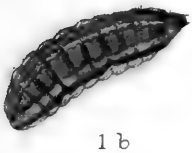
4 *a*, larva before last moult; 4, after last moult.

See pp. 9—12.

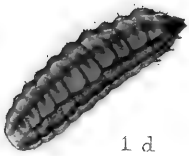
1 a

1

1 c



1 b



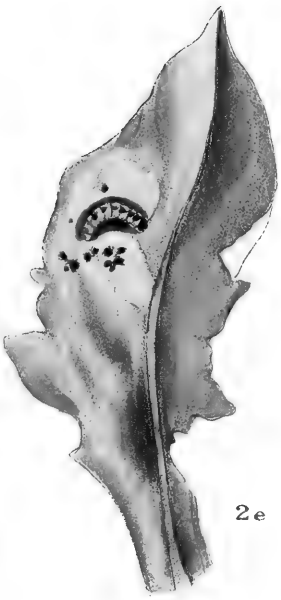
1 d

2

2 b

2 a

2d



2e

2 c

3

3 a

4

4 a

F.C. Moore lith.

W. BUCKLER *del.*

West, Newman & Co imp.

PLATE XIX.

Anthrocera exulans.

1, 1 *a*, 1 *b*, larva after last moult; 1 *c*, cocoon.

See pp. 13—18.

Anthrocera trifolii.

2, young larva; 2 *a*, 2 *b*, larva before last moult; 2 *c*, 2 *d*, after last moult.

See pp. 94—97.

Anthrocera loniceræ.

3, 3 *a*, larva after last moult; 3 *c*, magnified view of two segments of the larva, showing the spiracles; 3 *b*, cocoon, with empty pupa-skin protruding.

See pp. 18—20.

Anthrocera filipendulæ.

4, young larva; 4 *a*, 4 *b*, 4 *c*, 4 *d*, larva after last moult; the very dark larva (4 *c*) was found on *Lotus* in Monmouthshire; 4 *e*, cocoon.

See pp. 97—99.

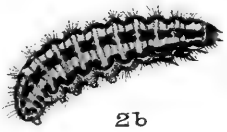
1

1c

1a

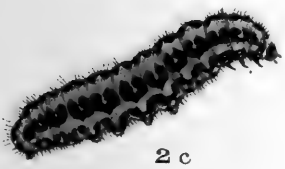
1b

2a

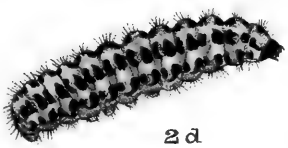


2b

2



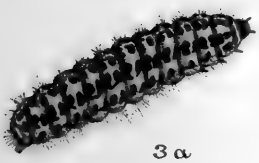
2c



2d

3b

3



3a

3c

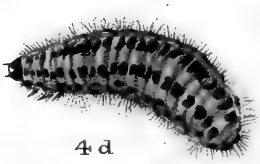
4b

4

4a

4e

4c



4d

F.C.Moore lith.

W.BUCKLER *del.*

West, Newman & Co. imp

PLATE XX.

Smerinthus ocellatus.

1, 1 *a*, 1 *b*, larva after last moult; the larva (1 *a*) was found on dwarf willow on sand-hills, near Instow, North Devon.

See pp. 99—103.

Smerinthus populi.

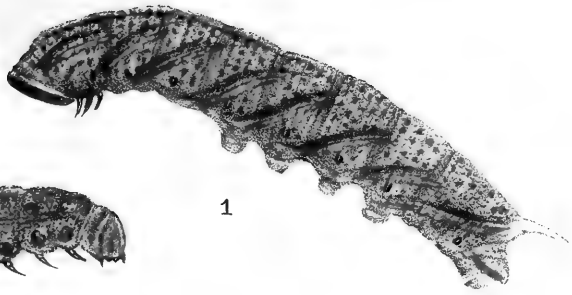
2, 2 *a*, 2 *b*, 2 *c*, larva after last moult.

See pp. 20—22 and 103, 104.

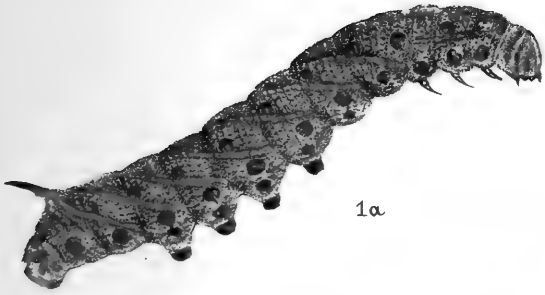
Smerinthus tiliæ.

3, 3 *a*, 3 *b*, larva after last moult.

See pp. 105—107.



1

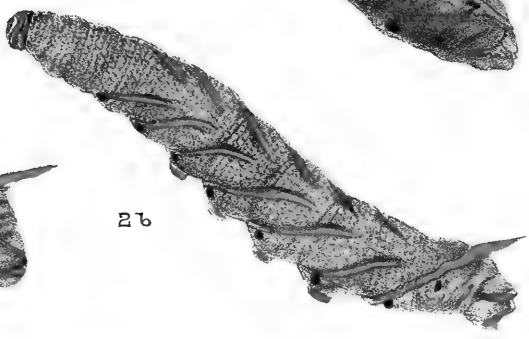


1a

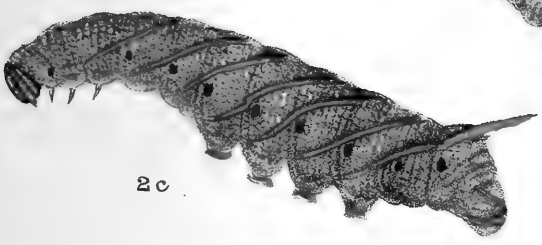
1b

2

2a



2b



2c

3

3a

3b

F.C.Moore lith.

W.BUCKLER *del.*

West, Newman & Co. imp

PLATE XXI.

Acherontia Atropos.

1, larva after last moult, of the ordinary type; 1 *a*, well-marked variety of the larva sometimes met with.

See pp. 107, 108.

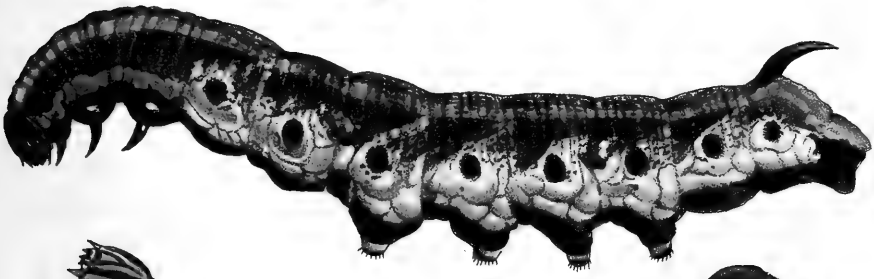
Sphinx convolvuli.

2, 2 *a*, 2 *b*, larva after last moult; 2 *c*, pupa. (See also Plate XXII.)

See pp. 22—26 and 108, 109.

1.

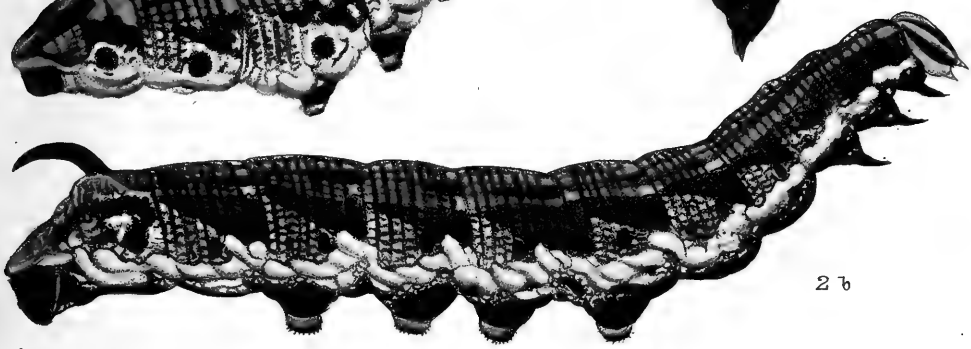
1a



2

2 a

2 c



2 b

F.C.Moore lith.

W. BUCKLER *del.*

West, Newman & C° imp.

PLATE XXII.

Sphinx convolvuli.

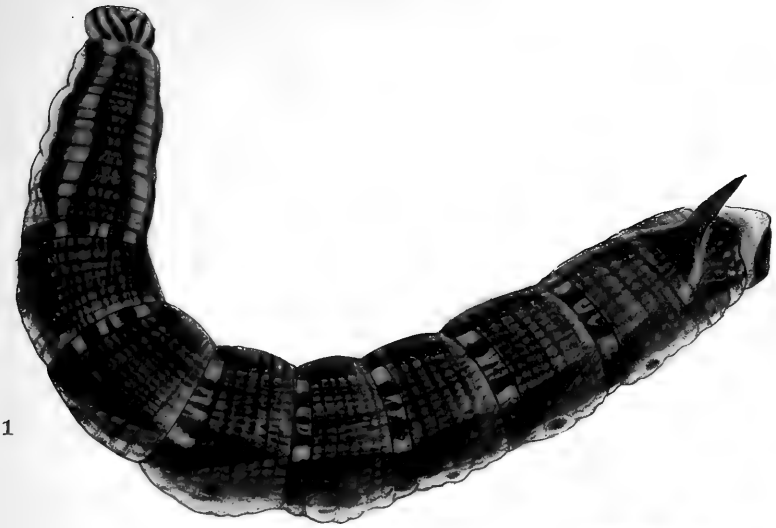
1, larva after last moult. (See also Plate XXI.)
See pp. 22—26 and 108, 109.

Sphinx ligustri.

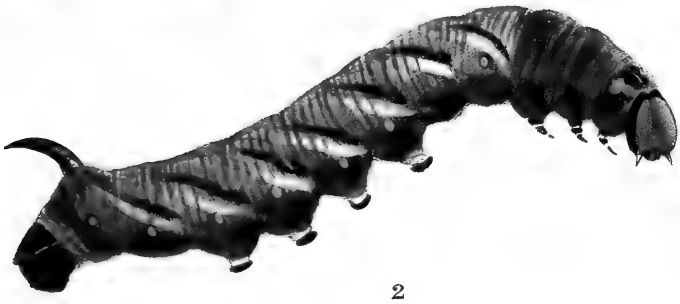
2 *a*, larva after last moult of the ordinary type; 2, larva of unusual coloration found on privet at Colchester, September, 1882.
See pp. 110—112.

Sphinx pinastri.

3, larva before last moult; 3 *a*, 3 *b*, after last moult.
See pp. 27—30 and 112, 113.

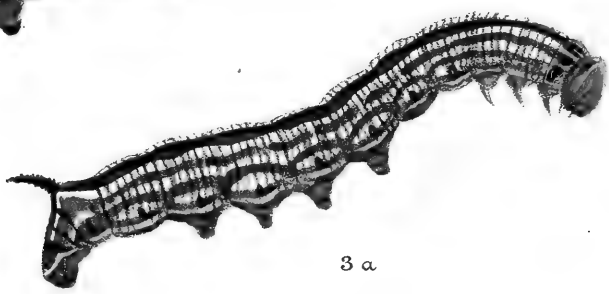


1

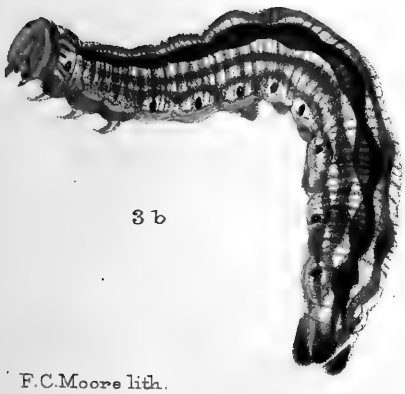


2

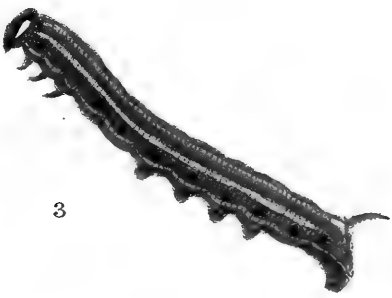
2 a



3 a



3 b



3

F.C.Moore lith.

W. BUCKLER *del.*

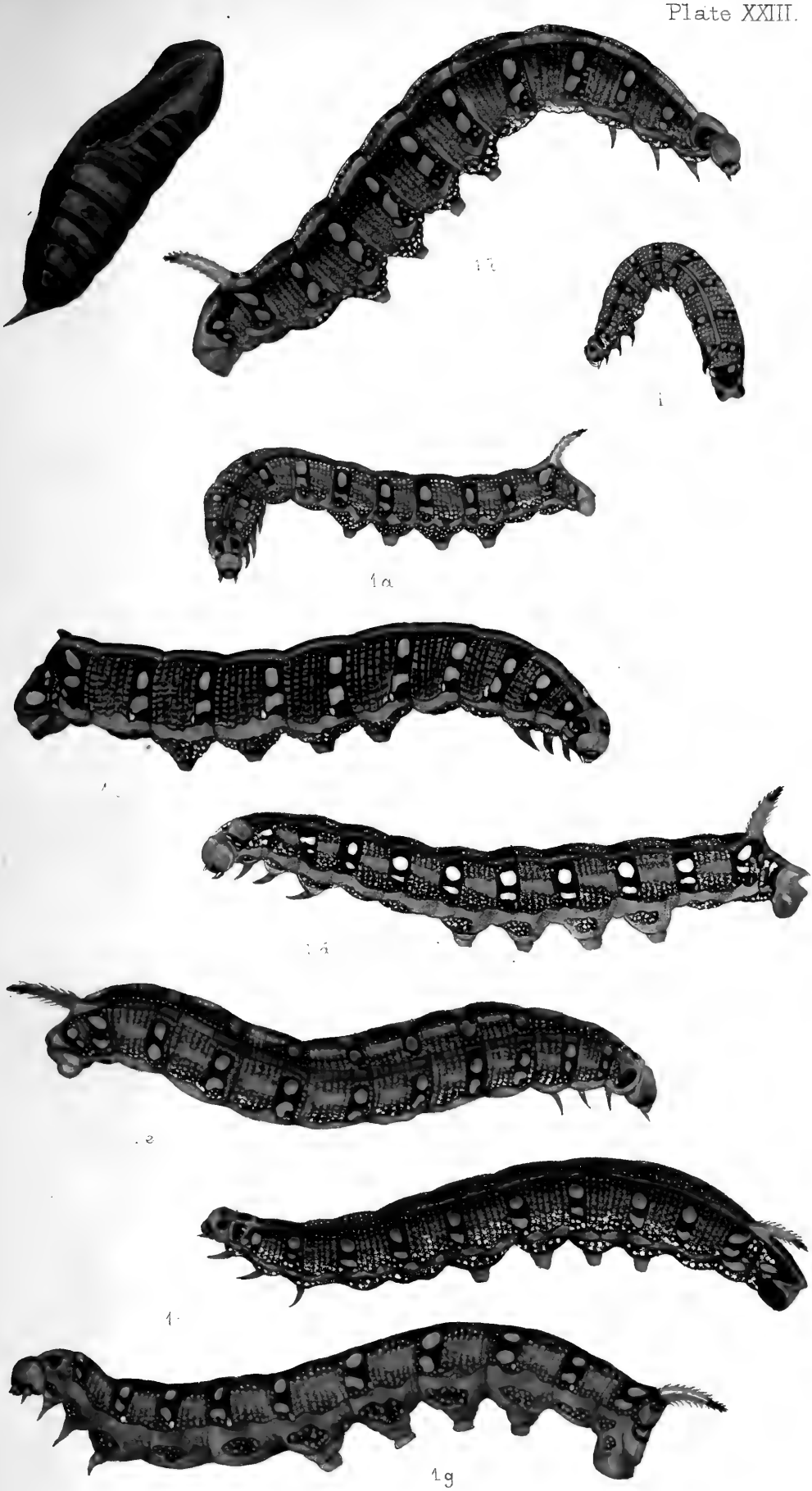
West, Newman & Co imp.

PLATE XXIII.

Deilephila euphorbiæ.

1, young larva; 1 *a*, larva before last moult; 1 *b*, 1 *c*, 1 *d*, 1 *e*, 1 *f*, 1 *g*, after last moult; 1 *h*, pupa.

See pp. 30—36.



F.C.Moore lith

W.BUCKLER *del.*

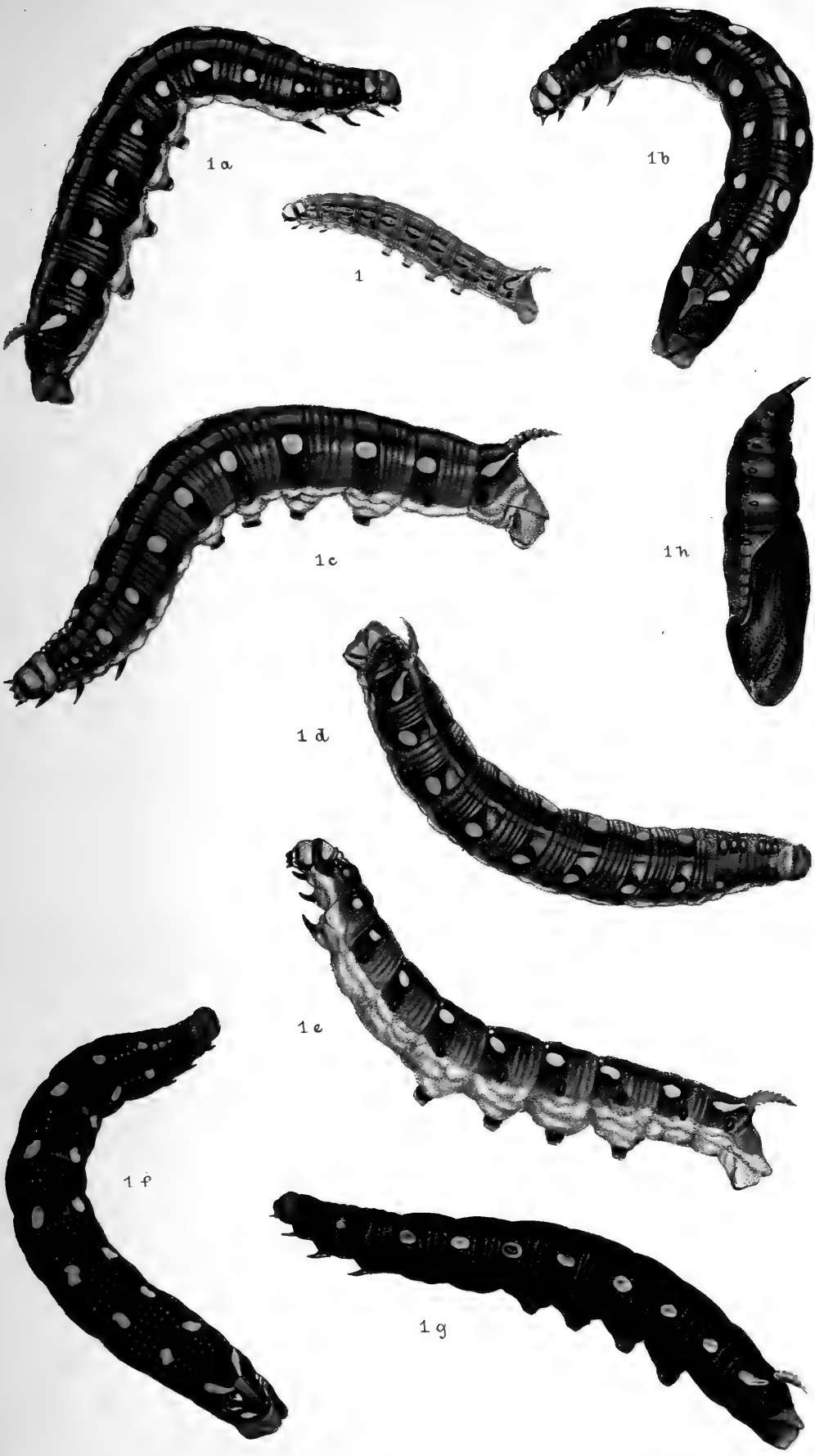
West, Newman & C°imp.

PLATE XXIV.

Deilephila galii.

1, young larva; 1 *a*, 1 *b*, 1 *c*, 1 *d*, 1 *e*, 1 *f*, 1 *g*, larva after last moult; 1 *h*, pupa.

See pp. 36—41.



F.C.Moore lith.

W.BUCKLER *del.*

West, Newman & Co. imp.

PLATE XXV.

Deilephila livornica.

1, larva after last moult; 1 *a*, pupa.

See pp. 42—45.

Chœrocampa celerio.

2, larva after last moult.

See p. 113.

Chœrocampa Elpenor.

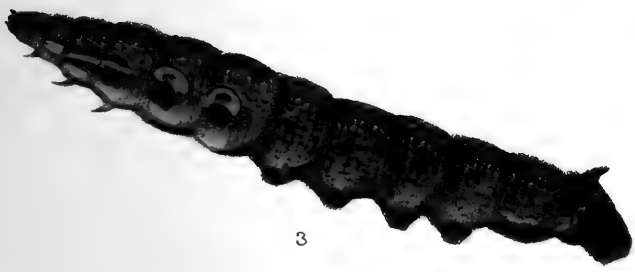
3, 3 *a*, 3 *b*, larva after last moult; 3 *c*, pupa.

See pp. 113—115.

1

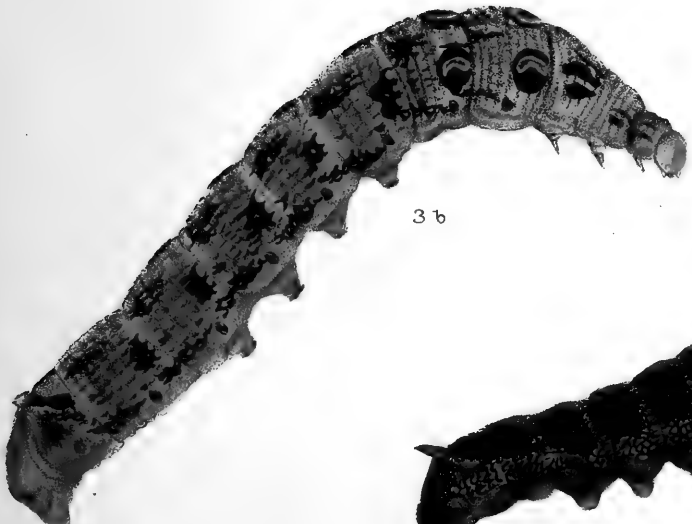
1 a

2

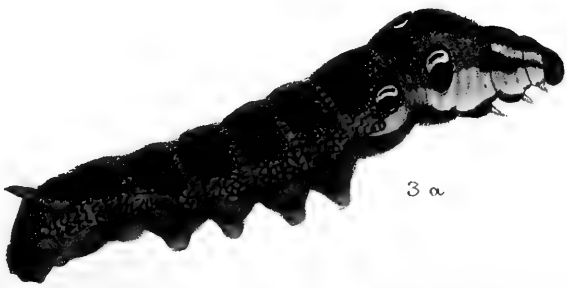


3

3 c



3 b



3 a

F.C.Moore lith.

W.BUCKLER *del.*

West, Newman & C° imp.

PLATE XXVI.

Chœrocampa porcellus.

1 *a*, larva before last moult; 1, 1 *b*, 1 *c*, after last moult.

See pp. 116—118.

Macroglossa stellatarum.

2, 2 *a*, 2 *b*, larva after last moult.

See pp. 118—121.

Sesia fuciformis.

3, 3 *a*, larva after last moult; 3 *b*, larva just before pupation; 3 *c*, pupa.

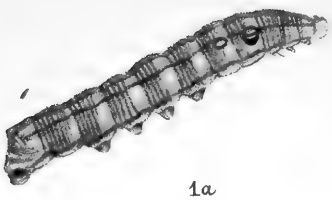
See pp. 121—122.

Sesia bombyliformis.

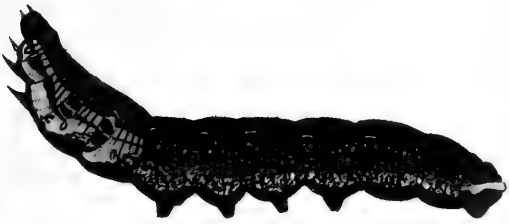
4, 4 *a*, larva after last moult.

See p. 122.

1

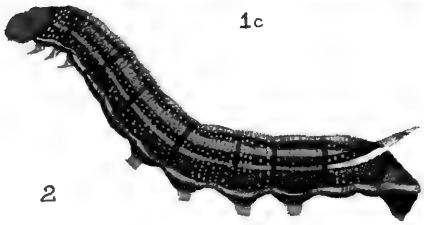


1a



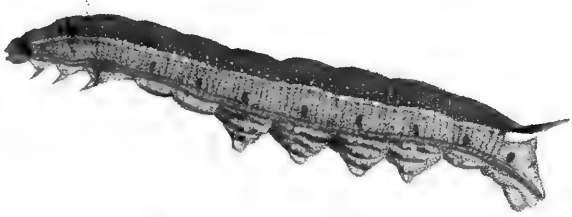
1c

1b



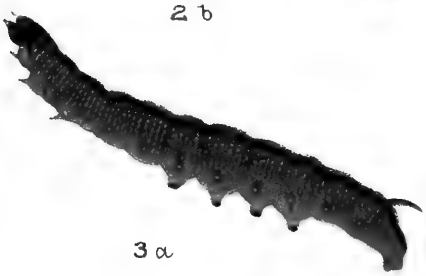
2

2a

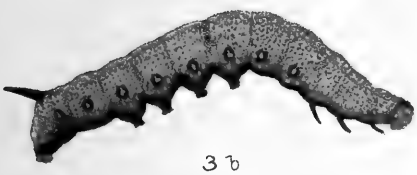


2b

3

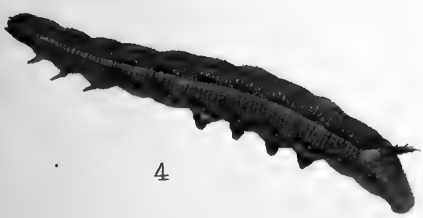


3a



3b

3c



4

4a

F.C.Moore lith.

W. BUCKLER *del.*

West, Newman & C.° imp.

PLATE XXVII.

Sphecia apiformis.

1, larva after last moult; 1 *a*, cocoon.
See pp. 123—125.

Sphecia bembeciformis.

2, larva before last moult; 2 *a*, after last moult.
See pp. 125, 126.

Trochilium chrysidiforme.

3, larva after last moult; 3 *a*, root of sorrel (*Rumex acetosa*) inhabited by the larva; 3 *b*, pupa.
See pp. 45, 46.

Trochilium ichneumoniforme.

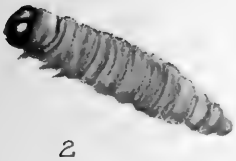
4, larva after last moult; 4 *a*, root of *Lotus corniculatus* inhabited by the larva; 4 *b*, pupa.
See pp. 46, 47.

Trochilium cynipiforme.

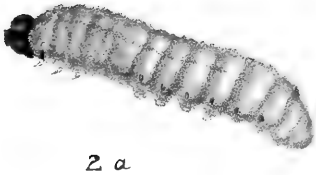
5, larva after last moult; 5 *a*, 5 *b*, pieces of oak-bark ravaged by the larva.
See pp. 47—49 and 126, 127.

1a

1



2



2 a

3 a

3

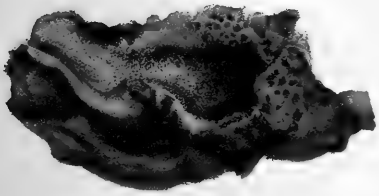
4

3 b

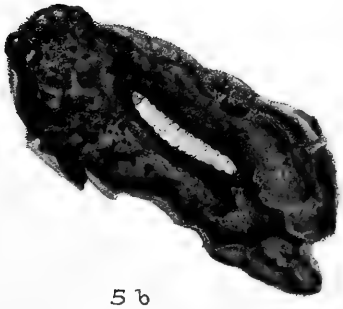
4 a

5

4 b



5 a



5 b

F.C. Moore lith.

West, Newman & C° imp.

W. BUCKLER *del*

PLATE XXVIII.

TROCHILIUM SPHEGIFORME.

1, larva after last moult; 1 *a*, section of alder branch showing burrow of the larva.

See p. 49 and 127.

TROCHILIUM SCOLIÆFORME.

2, larva after last moult; 2 *a*, 2 *b*, pieces of birch-bark burrowed by the larva.

See p. 127.

TROCHILIUM TIPULIFORME.

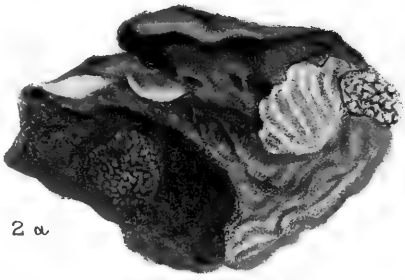
3, larva after last moult; 3 *a*, 3 *b*, stems of currant-bushes burrowed by the larva.

See pp. 49, 50 and 128.

1a

1

2



2a

2b

3a

3

3b

F.C.Moore lith.

W.BUCKLER *del.*

West, Newman & Co. imp.

PLATE XXIX.

Trochilium myopæforme.

1, larva before last moult; 1 *a*, after last moult; 1 *b*, pupa; 1 *c*, 1 *d*, pieces of apple-bark ravaged by the larva.

See pp. 128, 129.

Trochilium culiciforme.

2, larva after last moult.

See p. 129.

Trochilium formicæforme.

3, larva after last moult burrowing in stem of osier.

See p. 129.

Trochilium philanthiforme.

4, larva after last moult; 4 *a*, 4 *b*, tufts of thrift (*Statice armeria*) burrowed by the larva; 4 *b*, showing the long tubular gallery in which the pupa is contained.

See pp. 50—52.

1 c

1 b

1 d

1 a

3

2

4 a

4 b

4

F.C.Moore lith.

W.BUCKLER *del.*

West, Newman & Co imp.

PLATE XXX.

Hepialus hectus.

1, 1 *a*, larva after last moult in roots of fern (*Pteris aquilina*); 1 *b*, pupa.

See pp. 52—54.

Hepialus lupulinus.

2, larva after last moult; 2 *a*, pupa.

See pp. 129, 130.

Hepialus humuli.

3, 3 *a*, 3 *b*, larva after last moult; 3 *c*, pupa.

See pp. 131, 132.

Hepialus velleda.

4, 4 *a*, 4 *b*, larva after last moult; 4 *c*, pupa; 4 *d*, piece of root of fern (*Pteris aquilina*) burrowed by the larva.

See pp. 54—57.

Hepialus sylvinus.

5, larva after last moult burrowing in root of dock.

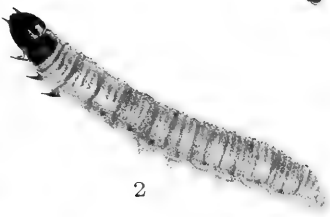
See pp. 57, 58.

1

1a

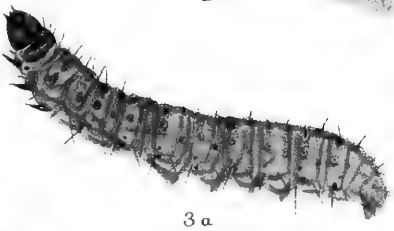
1b

2a



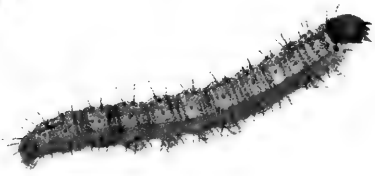
2

3



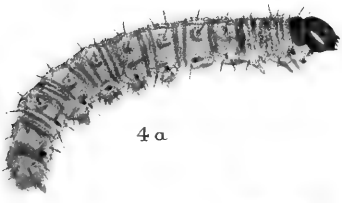
3a

3c

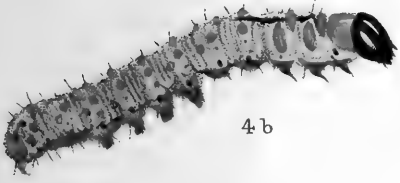


3b

4



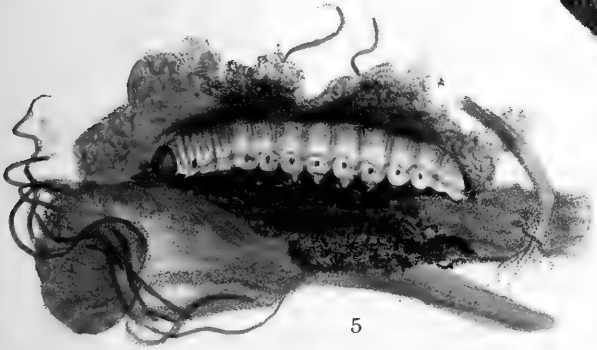
4a



4b

4c

4d



5

F. C. Moore lith.

West, Newman & Co. imp.

W. BUCKLER *del.*

PLATE XXXI.

Zeuzera æsculi.

1, 1 *a*, larva after last moult; 1 *b*, pupa; 1 *c*, cocoon.

See pp. 132, 133.

Phragmatæcia arundinis.

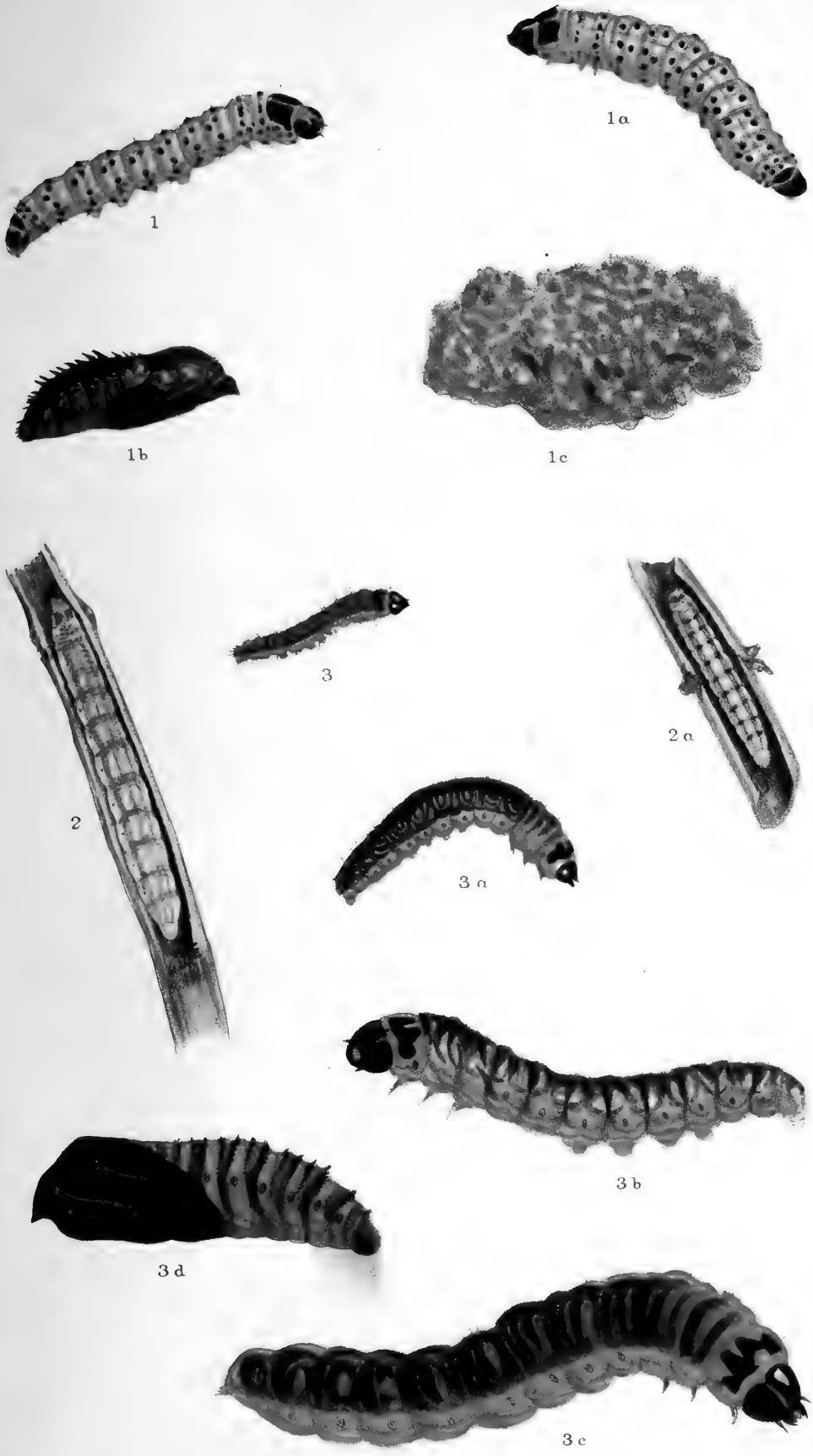
2 *a*, larva before last moult; 2, after last moult, in stems of reed.

See pp. 58, 59 and 133—135.

Cossus ligniperda.

3, 3 *a*, young larvæ, the age of which is uncertain; 3 *b*, larva supposed to be in its second year. This is the "second figure" spoken of by Mr. Buckler (see p. 59); 3 *c*, adult larva, the "first figure" of Mr. Buckler (see p. 59); 3 *d*, pupa.

See pp. 59—61 and 135—137.



F. C. Moore lith.

W. BUCKLER *del.*

West, Newman & C° imp.

PLATE XXXII.

Cerura bicuspis.

1, larva after last moult.

See pp. 62 and 137.

Cerura furcula.

2 *c*, larva before last moult; 2, 2 *a*, 2 *b*, after last moult; 2 *d*, bark of willow showing the cocoon.

See pp. 137—141.

Cerura bifida.

3, larva after last moult.

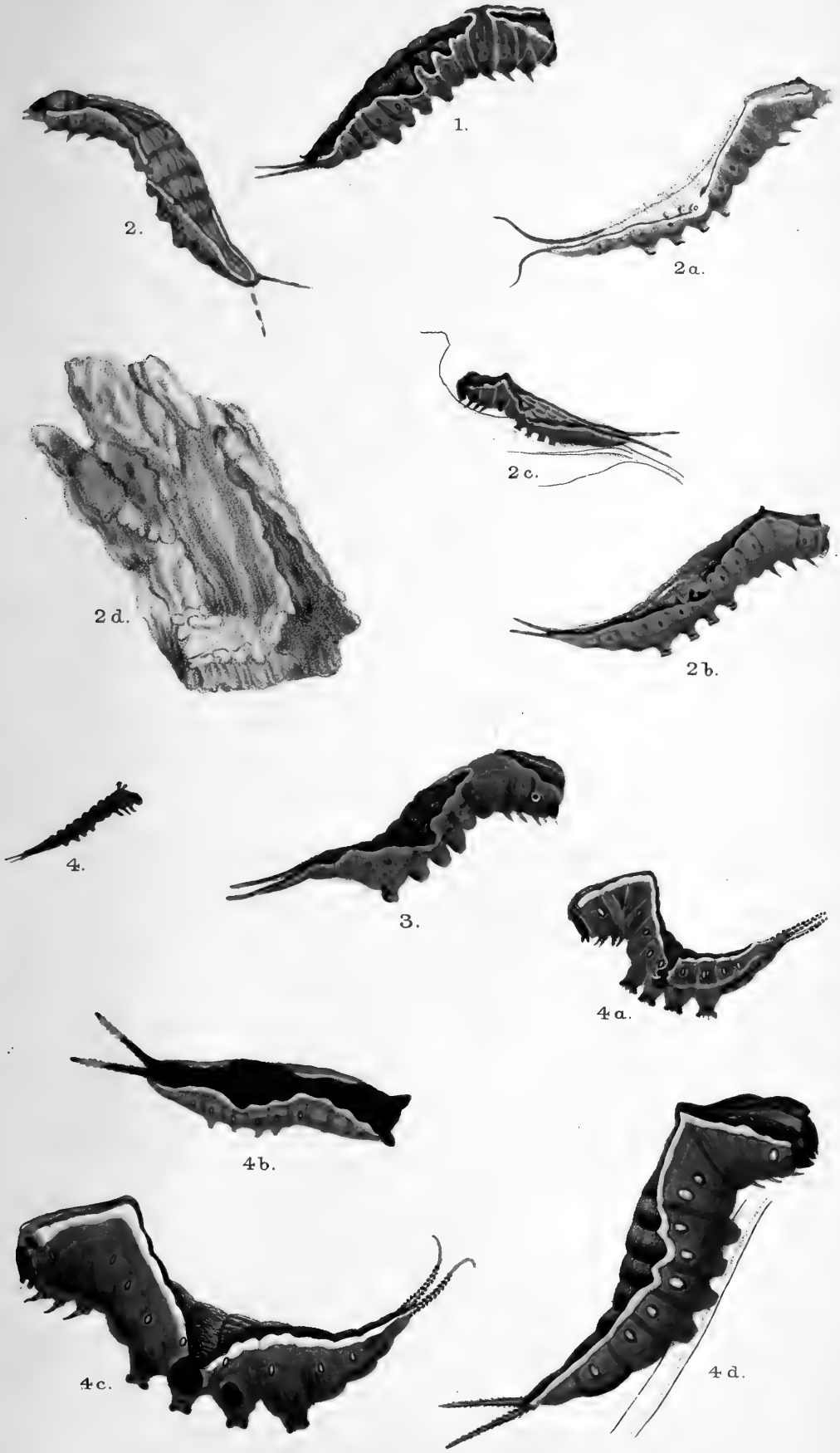
See pp. 141—143.

Cerura vinula.

4, young larva; 4 *a*, 4 *b*, larva before last moult; 4 *c*, 4 *d*, after last moult.

Figs. 4, 4 *a*, and 4 *c* are taken from the same individual at different stages of growth.

See pp. 143—150.



F.C.Moore lith. W. BUCKLER *del.* West, Newman & Cº imp.

PLATE XXXIII.

STAUROPUS FAGI.

1, 1 *a*, 1 *b*, 1 *c*, 1 *d*, larva after last moult, figured in various attitudes; 1 *e*, pupa.

See pp. 63—72.

NOTODONTA DROMEDARIUS.

2, 2 *a*, larva after last moult.

See pp. 150—152.

NOTODONTA TRITOPHUS.

3, 3 *a*, larva after last moult.

See pp. 72, 73.

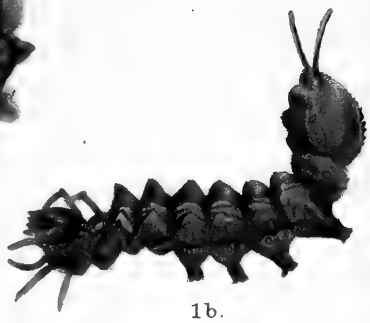
NOTODONTA ZICZAC.

4, larva after last moult.

See pp. 152—154.

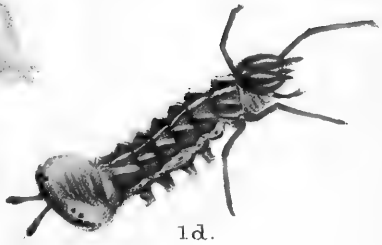
1.

1a.

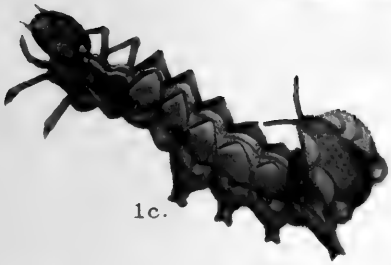


1b.

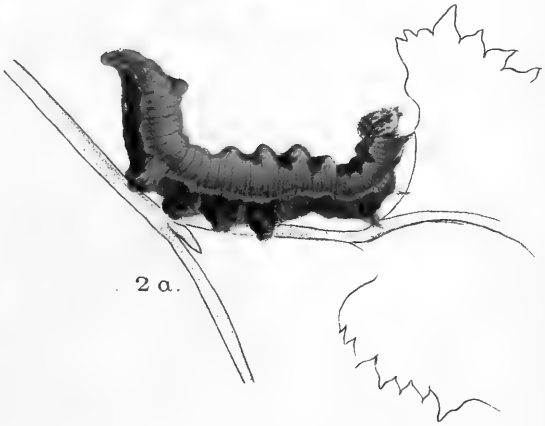
1e.



1d.

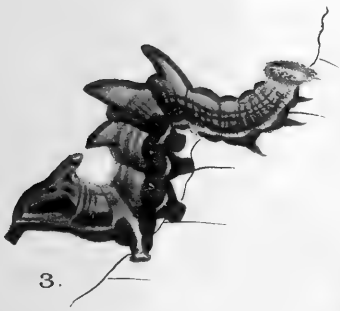


1c.



2a.

2.



3.

3a.

4.

F.C.Moore lith.

W. BUCKLER *del.*

West, Newman & C° imp.

PLATE XXXIV.

Pterostoma palpina.

1, 1 *a*, 1 *b*, larva after last moult.

See pp. 154, 155.

Ptilophora plumigera.

2, young larva; 2 *a*, larva before last moult; 2 *b*, 2 *c*, after last moult.

See pp. 73—76 and 156.

Drymonia chaonia.

3, 3 *a*, 3 *b*, larva after last moult.

See pp. 157, 158.

Drymonia dodonæa.

4, 4 *a*, 4 *b*, larva after last moult.

See p. 158.

Microdonta bicolora.

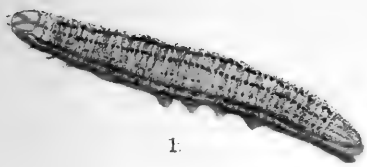
5 *a*, larva before last moult; 5, 5 *b*, after last moult.

See pp. 76—79.

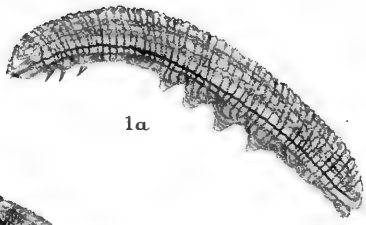
Gluphisia crenata.

6, 6 *a*, 6 *b*, larva after last moult.

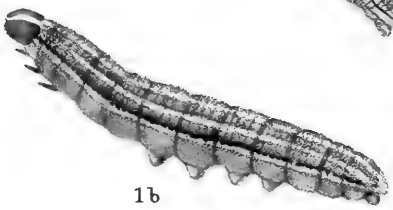
See pp. 80—83.



1.

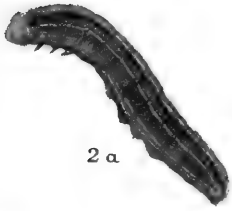


1a



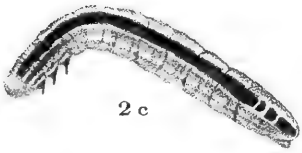
1b

2

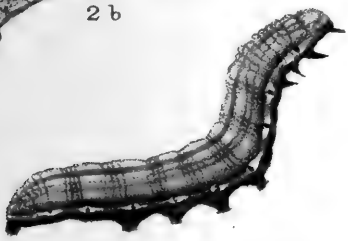


2a

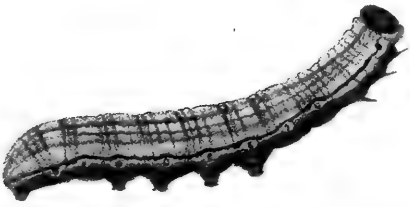
2b



2c



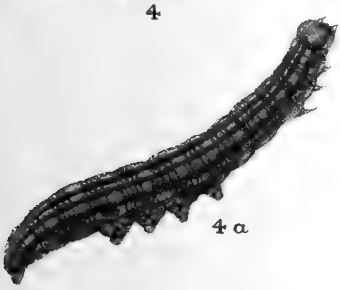
3



3a

3b

4

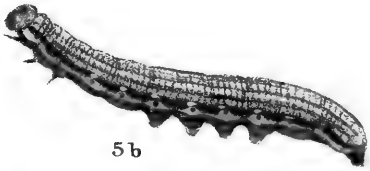


4a

4b

5

5a



5b

6a

6

6b

F. C. Moore lith.

West, Newman & C° imp.

W. BUCKLER *del.*

PLATE XXXV.

LEIOCAMPA DICTÆA.

1, 1 *a*, 1 *b*, larva after last moult.
See pp. 158—160.

LEIOCAMPA DICTÆOIDES.

2, 2 *a*, 2 *b*, larva after last moult.
See pp. 160—162.

LOPHOPTERYX CAMELINA.

3, 3 *a*, 3 *b*, 3 *c*, larva after last moult.
See pp. 162, 163.

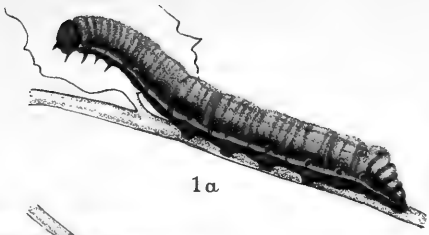
LOPHOPTERYX CUCULLINA.

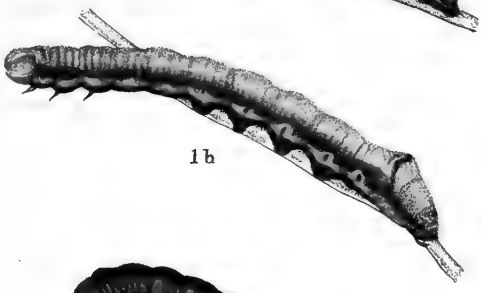
4, 4 *a*, 4 *b*, larva after last moult.
See pp. 164, 165.

LOPHOPTERYX CARMELITA.

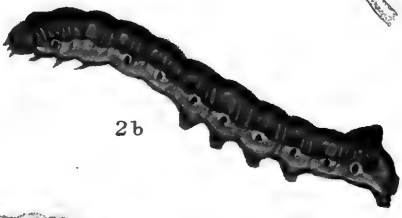
5, 5 *a*, 5 *b*, larva after last moult; 5 *c*, pupa.
See pp. 165, 166.

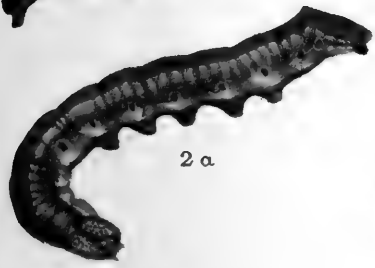

1

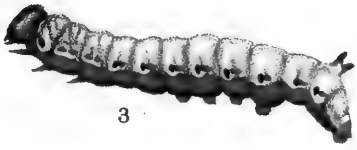

1a


1b

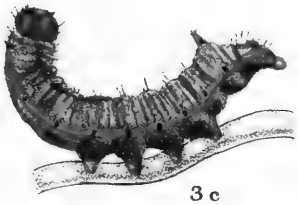

2

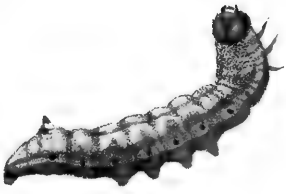

2b


2a

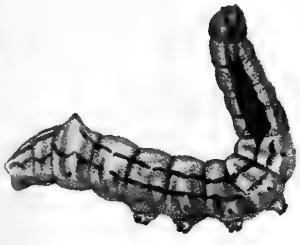

3

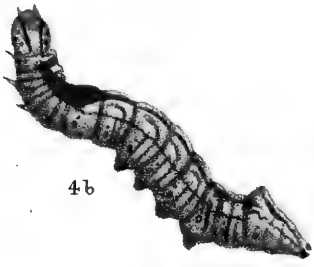

3a


3c

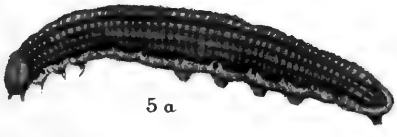

3b


4

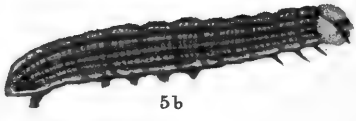

4a


4b


5


5a


5c


5b

F. C. Moore lith.

West, Newman & C°. imp.

W. BUCKLER *del.*

RAY SOCIETY.

INSTITUTED 1844.

FOR THE PUBLICATION OF WORKS ON NATURAL HISTORY.

ANNUAL SUBSCRIPTION ONE GUINEA.

LIST

OF

COUNCIL, OFFICERS, LOCAL SECRETARIES, AND MEMBERS,

TOGETHER WITH THE

TITLES OF THE PUBLICATIONS OF THE SOCIETY

CORRECTED TO FEBRUARY, 1887.

Council and Officers of the Ray Society,

Elected 17*th June*, 1886.

President.

SIR JOHN LUBBOCK, BART., M.P., F.R.S.

Council.

Dr. BASTIAN, F.R.S.
Dr. BRAITHWAITE, F.L.S.
Dr. CHURCH, F.L.S.
C. H. GATTY, Esq., M.A., F.L.S.
F. D. GODMAN, Esq., M.A., F.R.S.
F. GRUT, Esq., F.L.S.
E. HARRIS, Esq., F.L.S.
H. LEE, Esq., F.L.S.
R. M'LACHLAN, Esq., F.R.S.
Dr. MEIKLEJOHN, F.L.S.
A. D. MICHAEL, Esq., F.L.S.
Dr. J. MILLAR, F.L.S.
Prof. ST. G. MIVART, F.R.S.
F. P. PASCOE, Esq., F.L.S.
Dr. P. H. PYE-SMITH, F.L.S.
O. SALVIN, Esq., M.A., F.R.S.
H. T. STAINTON, Esq., F.R.S.
Capt. C. TYLER, F.L.S.
Dr. E. HART VINEN, F.L.S.
J. J. WEIR, Esq., F.L.S.
Lord WALSINGHAM, M.A., F.L.S.

Treasurer.

Dr. S. J. A. SALTER, F.R.S., F.L.S., Basingfield, Basingstoke, Hants.

Secretary.

Rev. Prof. THOMAS WILTSHIRE, M.A., F.L.S., 25, Granville Park, Lewisham, S.E.

LIST OF LOCAL SECRETARIES.

Birmingham	W. R. Hughes, Esq.
Leeds	L. C. Miall, Esq.
Liverpool	Isaac Byerley, Esq.
South Devon	G. C. Bignell, Esq.
Norwich	F. W. Harmer, Esq.
Warrington	T. G. Rylands, Esq.

LIST OF SUBSCRIBERS.*

Aberdeen, University of.
Adkin, R., Esq., F.E.S., Wellfield, Lingards road, Lewisham, S.E.
Adlard, J. E., Esq., Bartholomew close, E.C.
Alderson, Mrs., Park House, Worksop, Notts.
Allen, E. S., Esq., Shepherds Green, Chiselhurst.
Allman, Professor, F.R.S., &c., Ardmore, Parkstone, Poole, Dorset.
American Institute, New York.
Anderson, J., Esq., junr., Alre Villas, Chichester.
Andrews, Arthur, Esq., Newtown House, Blackrock, Dublin.
Angelin, Professor, Stockholm.
Argyll, Duke of, F.R.S., Argyll Lodge, Kensington, W.
Armstrong, Sir W. G., F.R.S., The Minories, Newcastle-on-Tyne.
Army and Navy Club, 36, Pall Mall, S.W.
Ash, Rev. C. D., Newport Pagnell, Bucks.
Asher, Messrs., 13, Bedford street, W.C.
Ashmolean Society, Oxford.
Asiatic Society of Bengal, 57, Park street, Calcutta (per Messrs. Trübner).
Athenæum Club, Pall Mall, S.W.
Aubrey, Rev. H. G. W., Rectory, Hale, Salisbury.

Babington, Professor Charles C., M.A., F.R.S., Cambridge.
Baer, Herr J., Frankfort.
Baillière, Messrs., 20, King William street, W.C.
Baker, Alfred, Esq., 59, Hagley road, Edgbaston, Birmingham.

* The Subscribers are requested to inform the Secretary of *any errors or omissions* in this List, and of any delay in the transmission of the Yearly Volume.

Balfour, Prof. J. B., F.R.S., Botanic Gardens, Oxford.
Baltimore, Peabody Institute.
Bankes, E. R., Esq., B.A., The Rectory, Corfe Castle.
Barker, H. W., Esq., 148, Hollydale road, Queen's road, Peckham, S.E.
Barrett, C. G., Esq., F.E.S., 68, Camberwell Grove, S.E.
Bastian, Dr. H. C., F.R.S., F.L.S., 20, Queen Anne street, W.
Bath Microscopical Society, care of C. Terry, Esq., 6, Gay street, Bath.
Beaufoy, Mark, Esq., 87, South Lambeth, S.
Becker, Rev. W., Willow Green Cottage, Willow, Newark-on-Trent, Notts.
Belfast Society for Promoting Knowledge, Linen Hall, Belfast.
Belfast, Queen's College.
Bergen, Museum of, Norway.
Berlin Royal Library.
Bignell, G. C., Esq., F.E.S., 7, Clarence place, Stonehouse, Plymouth.
Billups, T. R., Esq., F.E.S., 20, Swiss villas, Coplestone road, Peckham, S.E.
Binks, J., Esq., Wakefield.
Bird, G. W., Esq., Hurley Lodge, Honor Oak Park, S.E.
Birmingham, Free Library.
Birmingham, Mason College.
Birmingham Old Library.
Birmingham Natural History and Microscopical Society.
Blatch, W. G., Esq., Small Heath, Birmingham.
Blomefield, Rev. L., F.L.S., Z.S., 19, Belmont, Bath.
Bloomfield, Rev. E. N., M.A., F.E.S., Guestling, near Hastings.
Bond, F., Esq., 5, Fairfield Avenue, Staines, Middlesex.
Bostock, E., Esq., Stone, Staffordshire.
Bostock, F., Esq., jun., Northampton.
Boston Public Library, U.S.A.
Boswell, Dr. J. T., F.L.S., Balmuto, Kirkcaldy, N.B.
Bourne, T. W., Esq., Kyrewood, Tenbury.
Bower, B.A., Esq., Langley, Eltham Road, Lee, S.E.
Brabant, Monsieur E., Chateau de l'Alouette, Escaudœuvres, France.
Bradford Naturalists' Society, J. Eastwood, Esq., *Hon. Sec.*, 22, Whites terrace, Bradford.
Bradley, R. C., Esq., Raleigh buildings, 69, Snow hill, Birmingham.
Brady, H. B., Esq., F.L.S., Hillfield, Gateshead.
Brady, W. E., Esq., 1, Queen street, Barnsley, Yorkshire.

Braithwaite, Dr. R., F.L.S., The Ferns, Clapham rise, S.W.
Brevoort, Dr. J. Carson, New York.
Briggs, C. A., Esq., F.E.S., 55, Lincoln's Inn Fields, W.C.
Briggs, T. H., Esq., 55, Lincoln's Inn Fields, W.C.
Bright, P. M., Esq., Roccabruna, Bournemouth.
Brighton and Sussex Natural History Society, Brighton.
Bristol Microscopical Society, E. B. L. Brayley, Esq., *Hon. Sec.*, Rochdeane, Hughendon road, Clifton.
Brockholes, Mrs. J. Fitzherbert, Clifton hill, Garstang, Lancashire.
Brodrick, W., Esq., Little hill, Chudleigh, South Devon.
Brook, Geo., Esq., jun., F.L.S., Fernbrook, Huddersfield.
Broome, C. E., Esq., M.A., F.L.S., Elmshurst, Batheaston, Bath.
Browell, E. M., Esq., Feltham, Middlesex.
Browne, Dr. Henry, Woodheys, Heaton Mersey, Manchester.
Buckmaster, Rev. C. J., Hindley Vicarage, Wigan.
Buckton, G. B., Esq., F.R.S., Weycombe, Haslemere, Surrey.
Burn, Dr. W. B., Beechwood, Balham road, Upper Tooting, S.W.
Burney, Rev. H., Wavendon Rectory, Woburn.
Busk, Professor G., F.R.S., 32, Harley street, Cavendish square, W.
Byerley, I., Esq., F.L.S., *Local Secretary*, Seacombe, Cheshire.

Cambridge, Rev. O. P., Bloxworth Rectory, Wareham.
Cambridge Entomological Society, per J. Copper, Esq., Hon. Sec., Trinity College, Cambridge.
Cambridge, University Library.
Cambridge, University Museum of Zoology.
Cambridge, Downing College.
Cambridge, Gonville and Caius College.
Cambridge, St. Catharine's College.
Cambridge, Sidney-Sussex College.
Cambridge, Trinity College.
Campbell, F. M., Esq., F.L.S., Rose hill, Hoddesdon.
Canterbury, Philosophical Institute of, New Zealand.
Capper, S. J., Esq., F.L.S., Huyton Park, Huyton, near Liverpool.
Capron, Dr. E., F.E.S., Shiere, near Guildford, Surrey.
Carpenter, Dr. A., Duppas House, Croydon, S.
Carus, Dr. Victor, Leipsic.
Cash, W., Esq., Union Banking Company, Halifax.
Chapman, E., Esq., Frewen Hall, Oxford.
Chapman, T. A., Esq., Burghill, Hereford.

Cheltenham Permanent Library, Cheltenham.
Chicago Library, Chicago.
Chichester and West Sussex Natural History Society, per C. T. Halstead, Esq., Hon. Treas., Chichester.
Christiania, University of.
Church, Dr. W. S., 130, Harley Street, W.
Cincinnati Public Library.
Clark, J. A., Esq., M.P.S.G.B., L.D.S., F.E.S., The Broadway, London Fields, Hackney.
Cleland, Professor, 2, The College, Glasgow.
Clermont, Lord, Ravensdale park, Newry, Ireland.
Colman, Jeremiah J., Esq., M.P., Carrow House, Norwich.
Cooper, Colonel E. H., 42, Portman square, W.
Cooper, Sir Daniel, Bart., 6, De Vere gardens, Kensington Palace, W.
Coppin, John, Esq., Bingfield House, by Corbridge-on-Tyne, R.S.O.
Cork, Queen's College, Cork.
Cornwall, Royal Institution of, Truro.
Crallan, G. E., Esq., Cambridgeshire Asylum, Fulbourn, near Cambridge.
Craven, Alfred E., Esq., 65, St. George's road, S.W.
Cregoe, J. P., Esq., 9, Headland Park, Plymouth.
Cresswell, Mrs. R., Teignmouth, Devon.
Crisp, F., Esq., B.A., LL.B., V.P. and Treas. L. S., 6, Old Jewry, E.C.
Croft, R. Benyon, Esq., R.N., F.L.S., Farnham Hall, Ware, Herts.
Crowley, Philip, Esq., F.L.S., Wadden House, Croydon, S.
Cruickshank, Alexander, Esq., LL.D., 20, Rose street, Aberdeen.

Dale, C. W., Esq., F.E.S., Glanville Wootton, Sherborne, Dorset.
Daltry, Rev. T. W., M.A., F.L.S., Madeley Vicarage, Newcastle Staffordshire.
Darwin, F., Esq., F.R.S., Wychfield, Huntingdon Road, Cambridge.
Dawson, Sir J. W., F.R.S., F.G.S., M'Gill College, Montreal.
Decie, Miss A. Prescott, Bockleton Court, Tenbury.
Devon and Exeter Institution, Exeter.
Devonshire, Duke of, F.R.S., 78, Piccadilly, W.
Dickinson, Wm., Esq., 3, Whitehall place, S.W.
Dickson, Professor Alexander, LL.D., F.L.S., 11, Royal circus, Edinburgh.
Dobree, N. T., Esq., Beverley, Yorkshire.
Dohrn, Dr. Anton, Stazione Zoologica, Naples.

Douglas, J. W., Esq., F.E.S., 8, Beaufort gardens, Lewisham, S.E.
Douglas, Rev. R. C., Manaton Rectory, Moreton Hampstead, Exeter.
Douglas, W. D. R., Esq., F.L.S., Orchardton, Castle Douglas, N.B.
Dowsett, A., Esq., F.E.S., 54, Russell street, Reading.
Dublin, National Library.
Dublin, Royal Irish Academy.
Dublin Royal College of Science.
Dublin, Royal College of Surgeons.
Dublin, Trinity College.
Dublin, Hon. Society of King's Inn.
Ducie, Earl of, F.R.S., F.G.S., 16, Portman square, W.
Dunning, J. W., Esq., M.A., F.L.S., 12, Old square, Lincoln's Inn, W.C.

East Kent Natural History Society, Canterbury.
Edinburgh, Royal College of Physicians.
Edinburgh, Library of University of.
Edinburgh, Museum of Science and Art.
Edinburgh, Royal Society of.
Edinburgh, Royal Physical Society, 40, Castle street, Edinburgh.
Edwards, S., Esq., F.E.S., Kidbrooke Lodge, Blackheath, S.E.
Edwards, W. H., Esq., Coalburgh, West Virginia, United States.
Elisha, Geo., Esq., 122, Shepherdess Walk, City road.
Ellison, S. T., Esq., 2, Balhousie street, Perth, N.B.
Elphinstone, H. W., Esq., F.L.S., 2, Stone Buildings, Lincoln's Inn, W.C.
England, Bank of, Library, London, E.C.
England, Royal College of Surgeons of, Lincoln's-inn-fields, W.C.
Essex Field Club, per A. J. Lockyer, Esq., Stanley road, Woodford, Essex.
Evans, H. A., Esq., United Services College, Westward Ho, Bideford, N. Devon.

Fenn, C., Esq., Eversden House, Burnt Ash Hill, Lee, S.E.
Ffarington, Miss M. H., Worden Hall, near Preston.
Fitch, E. A., Esq., F.L.S., Maldon, Essex.
Fitch, Fred., Esq., F.R.G.S., Hadleigh House, Highbury New Park, N.
Flemyng, Rev. W. W., Coalfin House, Portland, Co. Waterford.
Fletcher, W. H. B., Esq., F.E.S., 6, The Steyne, Worthing, Sussex.
Flower, W. H., Esq., F.R.S., British Museum (Natural History), S.W.

Foster, C., Esq., Thorpe, Norwich.
Fraser, F. J., Esq., 16, Furnival Inn, E.C.
Freeman, F. F., Esq., F.E.S., 8, Leigham terrace, Plymouth.
Friedlander & Son, Messrs., Berlin.
Fuller, Rev. A., M.A., F.E.S., Pallant, near Chichester.

Galton, Capt. Douglas, F.R.S., 12, Chester street, Grosvenor place, S.W.
Gardner, J., Esq., 8, Friar terrace, Hartlepool.
Gatty, C. H., Esq., M.A., F.L.S., Felbridge place, East Grinstead, Sussex.
Geological Society, London, W.
Geological Survey of India, Calcutta, per Messrs. Trübner.
George, Frederick, Esq., Fairholme, Torquay.
Gibson, Mrs. G. S., Esq., Hill House, Saffron Walden, Essex.
Glasgow Natural History Society, 207, Bath street, Glasgow.
Glasgow, Philosophical Society of.
Glasgow, University of.
Godman, F. D., Esq., F.R.S., 10, Chandos street, Cavendish square, W., and South Lodge, Horsham.
Goldthwait, O. C., Esq., 2, Grove Villas, Grove road, Walthamstow.
Goode, J. F., Esq., 3, Regent place, Birmingham.
Gordon, Rev. George, LL.D., Manse of Birnie, by Elgin, N.B.
Göttingen, University of.
Green, R. Y., Esq., 11, Lovaine crescent, Newcastle-on-Tyne.
Grieve, Dr. J., F.R.S.E., F.L.S., care of W. L. Buchanan Esq., 212, St. Vincent street, Glasgow.
Grut, Ferdinand, Esq., F.L.S., 9, Newcomen street, Southwark, S.E.
Günther, Dr., F.R.S., British Museum (Natural History), Cromwell road, South Kensington, S.W.

Hackney Microscopical and Natural History Society, per J. A. Clark, Esq., Treasurer, 48, The Broadway, London fields, Hackney, E.
Haeckel, Professor, Jena, Prussia.
Haggerston Entomological Society.
Hailstone, Edward, Esq., F.S.A., Walton Hall, Wakefield.
Hancock, John, Esq., Newcastle-on-Tyne.
Harbottle, A., Esq., 6, Gibson terrace, Sunderland.
Harley, Dr. J., F.L.S., 9, Stratford place, W.
Harmer, Sidney F., Esq., B.Sc., King's College, Cambridge.

Harris, Edw., Esq., F.G.S., Rydal Villa, Longton grove, Upper Sydenham.
Harris, Dr. F., F.L.S., 24, Cavendish square, W.
Harris, J. T., Esq., F.E.S., Burton Bank, Burton-on-Trent.
Harrison, F., Esq., Junior United Service Club, S.W.
Harvard College, Cambridge, U.S.A.
Havers, J. C., Esq., Wood Lea, Bedford hill, Balham, S.W.
Hawker, H. G., Esq., Burleigh, Devonport.
Hawkins, Dr. B. L., Woburn, Beds.
Hawkshaw, J. C., Esq., 33, Great George street, Westminster, S.W.
Hellins, Rev. J., M.A., The Close, Exeter.
Hepburn, Sir T. B., Bart., Smeaton, Preston Kirk, N.B.
Hertfordshire Natural History Society and Field Club, Watford.
Hickling, G. H., Esq., Mudie's Select Library, W.C.
Hicks, Dr. John B., F.R.S., 24, George street, Hanover square, W.
Hillier, J. T., Esq., 4, Chapel place, Ramsgate.
Hilton, James, Esq., 60, Montagu square, W.
Hinchliff, Miss Katharine M., Worlington House, Instow.
Holdsworth, E. W. H., Esq., F.L.S., 84, Clifton hill, Abbey road, N.W.
Hooker, Sir J. D., C.B., M.D., F.R.S., Sunningdale, Berks.
Hope, the Rt. Hon. A. J. Beresford, Esq., M.P., Arklow House, Connaught place, W.
Hopkinson, John, Esq., F.L.S., F.G.S., The Grange, St. Alban's, Herts.
Horley, W. L., Esq., Stanboroughs, Hoddeston.
Houghton, Rev. W., F.L.S., Preston Rectory, Wellington, Salop.
Hovenden, F., Esq., F.L.S., Glenlea, Thurlow Park, Dulwich, S.E.
Howden, Dr. J. C., Sunnyside, Montrose.
Huddersfield Naturalists' Society, A. W. Whiteley, Esq., Hon. Sec., Westgate, Huddersfield.
Hughes, W. R., Esq., F.L.S., *Local Secretary*, Wood House, Handswood, Birmingham.
Hughes, W. Rathbone, Esq., 3, Princes Gate, Princes Park, Liverpool.
Hull Subscription Library.
Hunt, John, Esq., Milton of Campsie, Glasgow.
Hutchinson, Miss E., Grantsfield, Kimbolton, Leominster.
Huxley, Professor T. H., F.R.S., Science Schools, South Kensington.

Indian Museum, Calcutta.

James, H. B., Esq., F.Z.S., R.A.S., Valparaiso, Chili, care of Frank James, Esq., Aldridge, near Walsall, Staffordshire.
Janson, E. W., Esq., F.E.S., 35, Little Russell street, Bloomsbury.
Jenner, Charles, Esq., Easter Duddingsten Lodge, Portobello, Edinburgh.
Jones, Albert H., Esq., Shrublands, Eltham.
Jordan, Dr. R. C. R., 35, Harborne road, Edgbaston, Birmingham.

Kane, W. F. de V., Esq., M.R.I.A., F.E.S., Sloperton Lodge, Kingstown, Co. Dublin.
Kays, J. H., Esq., 33, Wimpole street, Plymouth.
Keays, Lovell H., Esq., F.L.S., 26, Charles street, St. James', S.W.
Kenderdine, F., Esq., Morningside, Old Trafford, Manchester.
Kenrick, G. H., Esq., Whetstone, Somerset road, Edgbaston, Birmingham.
Kent, W. Saville, Esq., F.L.S., Government Offices, Hobart Town, Tasmania.
Kilmarnock Library, Kilmarnock.
King, A., Esq., Aspley Guise, Woburn, Bedfordshire.
Kirby, W. F., Esq., 5, Burlington gardens, Chiswick, W.

Lascelles, A. A., Esq., 7, Stanley terrace, Plymouth.
Laver, H., Esq., F.L.S., Colchester.
Laxton, H., Esq., 41, Harpur street, Bedford.
Lee, Henry, Esq., F.L.S., F.G.S., Renton House, 343, Brixton road, S.W.
Leeds Philosophical and Literary Society.
Leicester, Alfred, Esq., Lynwood, Harbord street, Waterloo, near Liverpool.
Leicester Free Library, Wellington street, Leicester.
Leipzig, University of.
Lemann, F. C., Esq., M.E.S., Blackfriars House, Plymouth.
Lendy, Major A. F., F.L.S., F.G.S., Sunbury House, Sunbury.
Lidstone, W. G., Esq., 79, Union street, Plymouth.
Linnean Society, Burlington House, Piccadilly, W.
Lister, Arthur, Esq., F.L.S., Leytonstone.
Liverpool, Athenæum.
Liverpool, Royal Institution.

Liverpool Library, Lyceum, Liverpool.
Liverpool Medical Institution.
Liverpool Microscopical Society.
Liverpool Free Library.
Lloyd, A., Esq., F.E.S., The Dome, Bognor, Sussex.
Lobley, J. Logan, Esq., F.G.S., New Athenæum Club, Pall Mall.
Longstaff, G. B., Esq., Southfield Grange, West Hill road, Wandsworth, S.W.
London Institution, Finsbury circus, E.C.
London Library, 12, St. James's square, S.W.
Lovén, Professor, Stockholm.
Lubbock, Sir J., Bart., M.P., F.L.S., R.S., *President*, 15, Lombard street, E.C.

Marlborough College Natural History Society, Marlborough.
McGill, H. J., Esq., Aldenham Grammar School, Elstree, Herts.
McGregor, Rev. J., West Green, Culross, N.B.
McIntosh, Prof. W. C., M.D., F.R.S., 2, Abbotsford crescent, St. Andrew's, N.B.
McLachlan, R., Esq., F.R.S., West View, Clarendon road, Lewisham, S.E.
McMillan, W. S., Esq., 17, Temple street, Liverpool.
Maclagan, Prof. Douglas, M.D., F.R.S.E., 28, Heriot row, Edinburgh.
Maclaine, M. G., of Lochbuie, Isle of Mull.
Madras Government Museum, Madras.
Major, Charles, Esq., Red Lion Wharf, 69, Upper Thames street, E.C.
Manchester Free Public Library.
Manchester Literary and Philosophical Society.
Mansel-Pleydell, J., Esq., F.L.S., Whatcombe, Blandford.
Marshall, A. E., Esq., Waldersea, Beckenham.
Martin, G. M., Esq., Red Hill Lodge, Compton, Wolverhampton.
Mason, P. B., Esq., F.L.S., Burton-on-Trent.
Mathew, G. F., Esq., R.N., F.L.S., Z.S., Lee House, Dovercourt, near Harwich, Essex.
Mathews, W., Esq., M.A., F.G.S., 60, Harborne road, Birmingham.
Matthews, C., Esq., Erme Wood, Ivy Bridge, S. Devon.
Medlycott, Sir W., 6, Pulteney buildings, Weymouth.
Meiklejohn, Dr. J. W. S., F.L.S., 105, Holland road, Kensington, W.
Melbourne Public Library.

Mennell, H. T., Esq., F.L.S., 10, St. Dunstan's buildings, Idol lane, E.C.
Michael, A. D., Esq., F.L.S., Cadogan Mansions, Sloane square, S.W.
Microscopical Society, Royal, King's College, Strand, London.
Middleton, J. W., Esq., Fairfield, Headingley, Leeds.
Millar, Dr. John, F.L.S., F.G.S., Bethnall House, Cambridge road, N.E.
Miller, J. C., Esq., Lynmouth House, Langley road, Elmers End, Beckenham, Kent, S.E.
Mitchell Library, the, Glasgow.
Mivart, Prof. St. George J., F.R.S., Chilworth, Guildford.
Moore, Mrs. E. T., Sheffield.
Moseley, Sir T., Rolleston Hall, Burton-on-Trent.
Munich Royal Library, Munich.
Murdock, J. Barclay, Esq., F.R.Ph.S.E., Barclay, Langside, Glasgow.
Museum of Economic Geology, London, S.W.

Neave, B. W., Esq., Lyndhurst, Queen's road, Brownswood park, N.
Newcastle Literary and Philosophical Society, Newcastle-upon-Tyne.
Newman, T. P., Esq., 54, Hatton garden, E.C.
Noble, Capt. Jesmond Dene House, Newcastle-on-Tyne.
Noble, Wilson, Esq., 43, Warrior square, St. Leonard's-on-Sea.
Norfolk and Norwich Literary Institution, Norwich.
Norman, Rev. A. Merle, M.A., F.L.S., Burnmoor Rectory, Fencehouses, Durham.
Nottingham Free Library.
Nottingham Naturalists' Society, per W. H. Kay, Esq., Hon. Sec., Gresham Chambers, Nottingham.

Oldfield, G. W., Esq., M.A., F.L.S., 6, South Bank terrace, Stratford road, Kensington, W.
Owens College, Manchester.
Oxford, Magdalen College.

Paisley Philosophical Institute, Paisley.
Paris National Library, per Messrs. Longmans.
Parke, Geo. H., Esq., Infield Lodge, Barrow-in-Furness.
Parker, W. K., Esq., F.R.S., Crowland, Trinity road, Upper Tooting, S.W.

Pascoe, F. P., Esq., F.L.S., 1, Burlington road, Westbourne Park, W.
Pearce, W. G., 187, Caledonian road, King's Cross, N.
Peck, R. Holman, Esq., M.A., F.L.S., Elmfield, Penge lane, Sydenham, S.E.
Peckover, Algernon, Esq., F.L.S., Wisbeach.
Peel Park Library, Salford, Lancashire.
Penny, Rev. C. W., Wellington College, Wokingham.
Penzance Public Library.
Perthshire Society of Natural Science, Museum, Tay street, Perth.
Phené, J. S., Esq., LL.D., F.S.A., 5, Carlton terrace, Oakley street, S.W.
Philadelphia Academy of Natural Sciences, U.S.A.
Pierce, F. Nelson, Esq., 143, Smithdown lane, Liverpool.
Plymouth Institution, Athenæum, Plymouth.
Pole-Carew, Miss C. L., 3, South place, Rutland gate, S.W., and Antony, Torpoint, Devonport.
Pode, E. D. T., Esq., Slade, Ivy Bridge, Devon.
Porritt, G. T., Esq., F.L.S., Greenfield House, Huddersfield.
Power, H., Esq., 37A, Great Cumberland place, Hyde Park, W.
Preston Free Public Library.
Preston, Rev. T. A., M.A., F.L.S., Thurcaston Rectory, Leicester.
Pumphrey, C., Esq., Southfield, King's Norton, near Birmingham.
Pye-Smith, Dr. P. H., 54, Harley street, Cavendish square, W.

Quekett Microscopical Club, University College, W.C.

Radcliffe Library, Oxford.
Radford, D., Esq., Lydford Bridge, Bridestone, Devon.
Ramsay, Sir Andrew C., F.R.S., 15, Cromwell crescent, S.W.
Rashleigh, J., Esq., 3, Cumberland terrace, Regent's park, N.W.
Reader, Thomas, Esq., 39, Paternoster row, E.C.
Reading Microscopical Society, 110, Oxford road, Reading.
Reynell, Miss, Killynon, Killucan, Westmeath.
Rigby, Samuel, Esq., Fern Bank, Liverpool road, Chester.
Ripon, Marquis of, F.R.S., F.L.S., 1, Carlton gardens, S.W.
Robinson, Rev. F., The Rectory, Castle Eden, Co. Durham.
Robinson, Isaac, Esq., The Wash, Hertford.
Robson, J. E., Esq., 15, Northgate, Hartlepool.
Roper, F. C. S., Esq., F.L.S., F.G.S., Palgrave House, Eastbourne.
Rose, Geo., Esq., Queen street, Barnsley.

Ross, J. G., Esq., Bathampton Lodge, Bathampton, Bath.
Rothery, H. C., Esq., M.A., F.L.S., 94, Gloucester terrace, Hyde Park, W.
Royal Institution, Albemarle street, W.
Royal Medical and Chirurgical Society, 53, Berners street, W.
Royal Society, Burlington House, London, W.
Rowe, J. B., Esq., F.L.S., Plympton Lodge, Plympton, S. Devon.
Rowland-Brown, H., Esq., jun., Oxhey grove, Stanmore.
Rylands, T. G., Esq., F.L.S., *Local Secretary*, High Fields, Thelwall, near Warrington.

Salter, Dr. S. J. A., F.R.S., *Treasurer*, Basingfield, near Basingstoke, Hants.
Salvin, Osbert, Esq., F.R.S., 10, Chandos street, Cavendish square.
Samson and Wallin, Messrs., London.
Sanders, Alfred, Esq., F.L.S., Milton, Sittingbourne, Kent.
Sanford, W. A., Esq., F.G.S., Nynehead Court, near Wellington, Somersetshire.
Sang, J., Esq., 33, Oxford street, Darlington.
Science and Art Department, South Kensington.
Sclater, P. L., Esq., M.A., Ph.D., F.L.S., R.S., 11, Hanover square, W.
Shaldon, Dr. T. S., Cheshire County Asylum, Macclesfield.
Sharp, I., Esq., F.G.S., Culverden hill, Tunbridge Wells.
Sharpus, F. W., Esq., 30, Compton road, Islington, N.
Sheffield Literary and Philosophical Society.
Shillitoe, B., Esq., 2, Frederick place, Old Jewry, E.C.
Shuttleworth, Edmund, Esq., 6, Hall road, Hamilton terrace, St. John's Wood, N.W.
Sinclair, R. S., Esq., 16, Annfield terrace W., Parkhill, Glasgow.
Sion College Library, W.C.
Slack, H. I., Esq., F.G.S., Ashdown Cottage, Forest row, Sussex.
Sladen, Rev. C. A., Burghclere, Newbury.
Slatter, T. J., Esq., F.G.S., Evesham.
Smart, Robert B., Esq., 176, Waterloo place, Oxford road, Manchester.
Smith, Basil Woodd, Esq., F.R.A.S., Branch hill, Hampstead, N.W.
Smith, F. W., Esq., F.E.S., Hollywood, Lewisham hill, S.E.
Smith, S. P., Esq., 22, Ryletts road, Shepherd's Bush, W.
Somersetshire Archæological and Natural History Society, Taunton.
Sotheran, Messrs., 136, Strand, W.C.
South London Entomological Society, care of Edw. Step, Esq., 37, Charlwood road, Putney, S.W.

South London Microscopical Club, care of J. Guardia, Esq., Helston House, Rozel road, Clapham, S.W.
South, R., Esq., F.E.S., 12, Abbey gardens, St. John's Wood, N.W.
Southport Free Library.
Spicer, Messrs., Brothers, 19, New Bridge street, Blackfriars, E.C.
St. Andrew's University Library, St. Andrew's.
Stainton, H. T., Esq., F.R.S., L.S., Mountsfield, Lewisham, S.E.
Stebbing, Rev. T. R. R., Ephraim Lodge, The Common, Tunbridge Wells.
Stedman, A., Esq., M.R.C.S., L.S.A., L.M., The Croft, Great Bookham, Leatherhead.
Stephenson, J. W., Esq., Equitable Assurance Office, Mansion-house street, E.C.
Stewart, C., Esq., F.L.S., Royal College of Surgeons, Lincoln's Inn Fields, W.C.
Stockholm Royal Academy, Stockholm.
Stowell, Rev. H. A., Breadsall Rectory, near Derby.
Strasbourgh University Library.
Stroud Natural History and Philosophical Society, Stroud.
Stubbins, J., Esq., F.G.S., R.M.S., Inglebank, Far Headingly, Leeds.
Sunderland Subscription Library.
Swanston, W., Esq., F.G.S., 50, King street, Belfast.

Thompson, J. C., Esq., F.R.M.S., Woodstock, Waverley road, Liverpool.
Thornewell, Rev. C. F., The Soho, Burton-on-Trent.
Tomlinson, J. H., Esq., 7, Kirkgate, Newark.
Toronto, University of, Canada.
Torquay Natural History Society, Museum, Babbacombe road, Torquay.
Townsend, F., Esq., M.A., Honington Hall, Shipston-on-Stour.
Trübner & Co., Messrs., London.
Tugwell, W. H., Esq., 6, Lewisham road, Greenwich, S.E.
Turner, Professor W., F.R.S.E., University of Edinburgh.
Tyler, Captain Charles, F.L.S., F.G.S., Elberton, New West End, Hampstead, N.W.

University College, London.
Upsala, University of, Sweden.

Vass, M., Leipzig.
Vicars, John, Esq., sen., Seel street, Liverpool.
Vicary, William, Esq., The Priory, Colleton crescent, Exeter.
Vinen, Dr. E. Hart, F.L.S., 17, Chepstow villas, Bayswater, W.

Waldegrave, Earl, 13, Montague place, Bryanstone square, W.
Walker, Alfred O., Esq., Chester.
Walker, Rev. Dr. F. A., F.L.S., Duis Mallard, Cricklewood, N.W.
Walsingham, Thomas de Grey, Lord, M.A., F.L.S., Z.S., Merton Hall, Thetford, Norfolk.
Warden, Dr. Charles, Greenhurst, 44, Calthorp road, Edgbaston, Birmingham.
Warrington Museum and Library, Warrington.
Warwickshire Natural History Society, Warwick.
Washington Library of Congress, U.S.A.
Watkinson Library, Harford, Con., U.S.A.
Watt, A. P., Esq., 34, Paternoster row, E.C.
Webb, S., Esq., Maidstone House, Dover.
Weir, J. J., Esq., F.L.S., Chirbury, Copers Cope road, Beckenham, Kent.
Wells, J. R., Esq., 20, Fitzroy street, Fitzroy square, W.C.
Wesley, E. F., Esq., A.K.C., 28, Essex street, Strand, W.C.
West Kent Natural History Society, Lewisham, S.E.
Wheeler, F. D., Esq., Paragon House School, Norwich.
Whittle, F. G., Esq., 2, Cambridge terrace, Lupus street, S.W.
Wills, A. W., Esq., F.C.S., Wylde Green, Erdington, Birmingham.
Wilson, Owen, Esq., F.E.S., Cwmffrwd, Carmarthen.
Wiltshire, Rev. Professor T., M.A., F.L.S., *Treas.* G.S., *Secretary*, 25, Granville park, Lewisham, London, S.E.
Wollaston, G. H., Esq., 4, College road, Clifton, near Bristol.
Wood, J. H., Esq., M.B., Tarrington, Ledbury.
Woodd, B. T., Esq., Conyngham Hall, Knaresborough, Yorkshire.
Wright, Professor E. P., F.L.S., Trinity College, Dublin.

Yale College, New Haven, U.S.
York Philosophical Society, York.

Zoological Society, 11, Hanover square, W.

LIST OF THE ANNUAL VOLUMES

OF THE

RAY SOCIETY.

FROM THEIR COMMENCEMENT, IN 1844, TO MARCH, 1887.

LIST OF THE ANNUAL VOLUMES ISSUED BY THE RAY SOCIETY.

For the First Year, 1844.

I. Reports on the Progress of Zoology and Botany. Translated by H. E. Strickland, Jun., M.A., F.R.S., E. Lankester, M.D., F.R.S., and W. B. Macdonald, B.A. 8vo.

II. Memorials of John Ray: consisting of the Life of John Ray, by Derham; the Biographical Notice of Ray, by Baron Cuvier and M. Dupetit Thouars, in the 'Biographie Universelle;' Life of Ray, by Sir J. E. Smith: the Itineraries of Ray, with Notes, by Messrs. Babington and Yarrell. Edited by E. Lankester, M.D., F.R.S. 8vo.

III. A Monograph of the British Nudibranchiate Mollusca. By Messrs. Alder and Hancock. Part I. Ten Plates. Imp. 4to.

For the Second Year, 1845.

I. Steenstrup on the Alternation of Generations. Translated from the German, by George Busk, F.R.S. Three Plates. 8vo.

II. A Monograph of the British Nudibranchiate Mollusca. By Messrs. Alder and Hancock. Part II. Thirteen Plates. Imp. 4to.

III. Reports and Papers on Botany, consisting of Translations from the German. Translated by W. B. Macdonald, B.A.; G. Busk, F.R.S.; A. Henfrey, F.R.S.; and J. Hudson, B.M. Seven Plates. 8vo.

For the Third Year, 1846.

I. Meyen's Geography of Plants. Translated from the German by Miss Margaret Johnston. 8vo.

II. Burmeister on the Organization of Trilobites. Translated from the German, and edited by Professors T. Bell and E. Forbes. Six Plates. Imp. 4to.

III. A Monograph of the British Nudibranchiate Mollusca. By Messrs. Alder and Hancock. Part III. Eleven Plates. Imp. 4to.

For the Fourth Year, 1847.

I. Oken's Elements of Physio-philosophy. Translated from the German by Alfred Tulk. 8vo.

II. Reports on the Progress of Zoology. Translated from the German by Messrs. Geo. Busk, A. H. Haliday, and A. Tulk. 8vo.

III. A Synopsis of the British Naked-eyed Pulmograde Medusæ. By Professor E. Forbes, F.R.S. Thirteen Plates. Imp. 4to.

For the Fifth Year, 1848.

I. Bibliographia Zoologiæ et Geologiæ. By Professor Agassiz. Vol. I. 8vo.

II. Letters of John Ray. Edited by E. Lankester, M.D., F.R.S. Two Plates. 8vo.

III. A Monograph of the British Nudibranchiate Mollusca. By Messrs. Alder and Hancock. Part IV. Twelve Plates. Imp. 4to.

FOR THE SIXTH YEAR, 1849.

I. Reports and Papers on Vegetable Physiology and Botanical Geography. Edited by A. Henfrey, F.R.S. Three Plates 8vo.

II. A Monograph of the British Entomostracous Crustacea. By W. Baird, M.D., F.R.S. Thirty-six Plates. 8vo.

FOR THE SEVENTH YEAR, 1850.

I. Bibliographia Zoologiæ et Geologiæ. By Professor Agassiz. Vol. II. 8vo.

II. A Monograph of the British Nudibranchiate Mollusca. By Messrs. Alder and Hancock. Part V. Fifteen Plates. Imp. 4to.

FOR THE EIGHTH YEAR, 1851.

I. A Monograph of the British Angiocarpous Lichens. By the Rev. W. A. Leighton, M.A. Thirty Plates. 8vo.

II. A Monograph of the Family Cirripedia. By C. Darwin, M.A., F.R.S. Vol. I. Ten Plates. 8vo.

FOR THE NINTH YEAR, 1852.

I. Bibliographia Zoologiæ et Geologiæ. By Professor Agassiz. Vol. III. 8vo.

II. A Monograph of the British Nudibranchiate Mollusca. By Messrs. Alder and Hancock. Part VI. Twelve Plates. Imp. 4to.

FOR THE TENTH YEAR, 1853.

I. A Monograph of the Family Cirripedia. By C. Darwin, M.A., F.R.S. Vol. II. Thirty Plates. 8vo.

II. A Volume of Botanical and Physiological Memoirs, including Braun on Rejuvenescence in Nature. Six Plates. 8vo.

FOR THE ELEVENTH YEAR, 1854.

Bibliographia Zoologiæ et Geologiæ. By Professor Agassiz. Vol. IV. 8vo. (Completing the work.)

FOR THE TWELFTH YEAR, 1855.

A Monograph of the British Nudibranchiate Mollusca. By Messrs. Alder and Hancock. Part VII. Nine Plates. Imp. 4to. (Completing the work.)

FOR THE THIRTEENTH YEAR, 1856.

A Monograph of the British Fresh-water Polyzoa. By Professor Allman, F.R.S. Eleven Plates. Imp. 4to.

FOR THE FOURTEENTH YEAR, 1857.

A Monograph of the Recent Foraminifera of Great Britain. By Professor Williamson, F.R.S. Seven Plates. Imp. 4to.

FOR THE FIFTEENTH YEAR, 1858.

The Oceanic Hydrozoa. By Professor Huxley, F.R.S. Twelve Plates. Imp. 4to.

FOR THE SIXTEENTH YEAR, 1859.

A History of the Spiders of Great Britain and Ireland. By John Blackwall, F.L.S. Part I. Twelve Plates. Imp. 4to.

FOR THE SEVENTEENTH YEAR, 1860.

An Introduction to the Study of the Foraminifera. By W. B. Carpenter, M.D., F.R.S., F.L.S., &c., assisted by W. K. Parker, F.R.S., and T. Rupert Jones, F.G.S. Twenty-two Plates. Imp. 4to.

FOR THE EIGHTEENTH YEAR, 1861.

On the Germination, Development, and Fructification of the Higher Cryptogamia, and on the Fructification of the Coniferæ. By Dr. Wilhelm Hofmeister. Translated by Frederick Currey, M.A., F.R.S., Sec. L.S. Sixty-five Plates. 8vo.

For the Nineteenth Year, 1862.

A History of the Spiders of Great Britain and Ireland. By John Blackwall, F.L.S. Part II. Seventeen Plates. Imp. 4to. (Completing the work.)

For the Twentieth Year, 1863.

The Reptiles of British India. By Albert C. L. G. Günther, M.D., F.R.S. Twenty-six Plates. Imp. 4to.

For the Twenty-first Year, 1864.

A Monograph of the British Spongiadæ. By J. S. Bowerbank, LL.D., F.R.S. Vol. I. Thirty-seven Plates. 8vo.

For the Twenty-second Year, 1865.

I. The British Hemiptera Heteroptera. By Messrs. J. W. Douglas and John Scott. Twenty-one Plates. 8vo.

II. A Monograph of the British Spongiadæ. By J. S. Bowerbank, LL.D., F.R.S. Vol. II. 8vo.

For the Twenty-third Year, 1866.

I. The Miscellaneous Botanical Works of Robert Brown, D.C.L., F.R.S. Vol. I, containing Geographico-botanical, and Structural, and Physiological Memoirs. Edited by J. J. Bennett, F.R.S. 8vo.

II. Recent Memoirs on the Cetacea. By Professors Eschricht, Reinhardt, and Lilljeborg. Edited by W. H. Flower, F.R.S. Six Plates. Imp. 4to.

III. Nitzch's Pterylography, translated from the German. Edited by P. L. Sclater, F.R.S. Ten Plates. Imp. 4to.

FOR THE TWENTY-FOURTH YEAR, 1867.

I. A Monograph on the Structure and Development of the Shoulder-girdle. By W. K. Parker, F.R.S. Thirty Plates. Imp. 4to.

II. The Miscellaneous Botanical Works of Robert Brown, D.C.L., F.R.S. Vol. II. 8vo.

FOR THE TWENTY-FIFTH YEAR, 1868.

I. Vegetable Teratology. By M. T. Masters, M.D., F.L.S. 8vo.

II. The Miscellaneous Botanical Works of Robert Brown, D.C.L., F.R.S. Vol. III. Thirty-eight Plates. Imp. 4to. (Completing the work.)

FOR THE TWENTY-SIXTH YEAR, 1869.

A Monograph of the Gymnoblastic or Tubularian Hydroids. By J. Allman, M.D., F.R.S. Part I. Twelve Plates. Imp. 4to.

FOR THE TWENTY-SEVENTH YEAR, 1870.

A Monograph of the Gymnoblastic or Tubularian Hydroids. By J. Allman, M.D., F.R.S. Part II. Eleven Plates. Imp. 4to. (Completing the work.)

For the Twenty-eighth Year, 1871.

A Monograph of the Collembola and Thysanura. By Sir J. Lubbock, Bart., M.P., F.R.S. Seventy-eight Plates. 8vo.

For the Twenty-ninth Year, 1872.

A Monograph of the British Annelids. By W. C. McIntosh, M.D., F.R.S.E. Part I. Ten Plates. Imp. 4to.

For the Thirtieth Year, 1873.

A Monograph of the British Annelids. By W. C. McIntosh, M.D., F.R.S.E. Part I. continued. Thirteen Plates. Imp. 4to.

For the Thirty-first Year, 1874.

A Monograph of the British Spongiadæ. By J. S. Bowerbank, LL.D., F.R.S. Vol. III. Ninety-two Plates. 8vo.

For the Thirty-second Year, 1875.

A Monograph of the British Aphides. By G. B. Buckton, F.R.S. Vol. I. Forty-two Plates. 8vo.

For the Thirty-third Year, 1876.

A Monograph of the British Copepoda. By G. S. Brady, M.D., F.L.S. Vol. I. Thirty-six Plates. 8vo.

FOR THE THIRTY-FOURTH YEAR, 1877.

A Monograph of the British Aphides. By G. B. Buckton, F.R.S. Vol. II. Fifty Plates. 8vo.

FOR THE THIRTY-FIFTH YEAR, 1878.

A Monograph of the British Copepoda. By G. S. Brady, M.D., F.L.S. Vol. II. Forty-nine Plates. 8vo.

FOR THE THIRTY-SIXTH YEAR, 1879.

I. A Monograph of the British Copepoda. By G. S. Brady, M.D., F.L.S. Vol. III. Eleven Plates. 8vo. (Completing the work.)

II. A Monograph of the British Spongiadæ. By the late J. S. Bowerbank, LL.D., F.R.S. Edited, with additions, by Rev. A. M. Norman, M.A., F.L.S. Vol. IV. Seventeen Plates. 8vo. (Completing the work.)

FOR THE THIRTY-SEVENTH YEAR, 1880.

A Monograph of the British Aphides. By G. B. Buckton, F.R.S. Vol. III. Twenty-eight Plates. 8vo.

FOR THE THIRTY-EIGHTH YEAR, 1881.

A Monograph of the British Phytophagous Hymenoptera. By P. Cameron. Vol. I. Twenty-one Plates. 8vo.

For the Thirty-ninth Year, 1882.

A Monograph of the British Aphides. By G. B. Buckton, F.R.S. Vol. IV. Twenty-seven Plates. 8vo. (Completing the Work.)

For the Fortieth Year, 1883.

British Oribatidæ. By A. D. Michael, F.L.S. Vol. I. Thirty-one Plates. 8vo.

For the Forty-first Year, 1884.

A Monograph of the British Phytophagous Hymenoptera. By P. Cameron. Vol. II. Twenty-seven Plates. 8vo.

For the Forty-second Year, 1885.

The Larvæ of the British Butterflies and Moths. By the late W. Buckler, edited by H. T. Stainton. Vol. I. The Butterflies. Seventeen Plates. 8vo.

For the Forty-third Year, 1886.

The Larvæ of the British Butterflies and Moths. By the late W. Buckler, edited by H. T. Stainton. Vol. II. The Hawk-Moths and part of the Bombyces. Eighteen Plates. 8vo.

PRINTED BY ADLARD AND SON, BARTHOLOMEW CLOSE.